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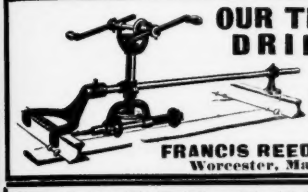

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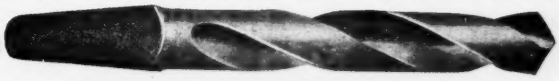
High  Grade

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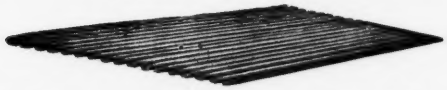

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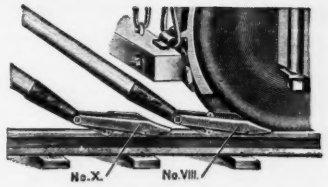

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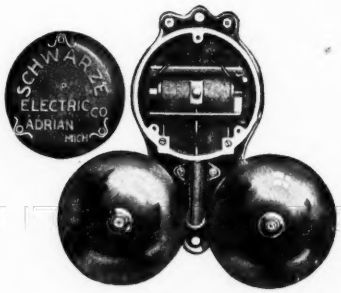

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FIG. 1—Showing ballast removed from end of ties to be raised, track jacked up and device in position to receive ballast for placing under tie.

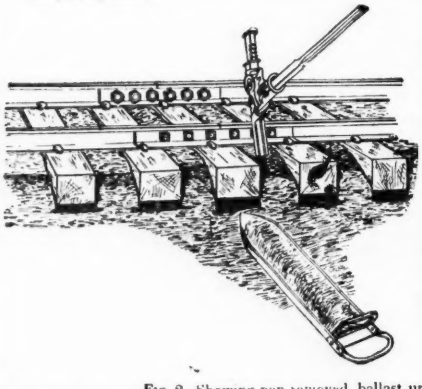

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FIG. 2—Showing pan removed, ballast under tie, and cleaner ready to be withdrawn.

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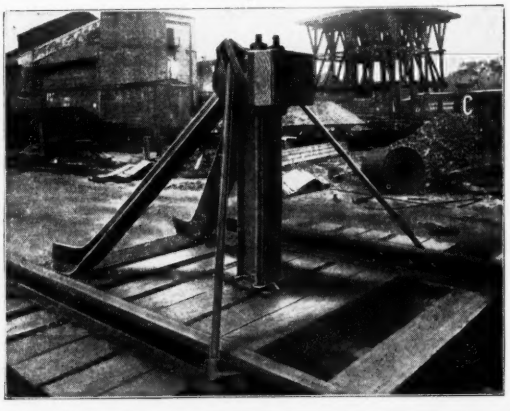

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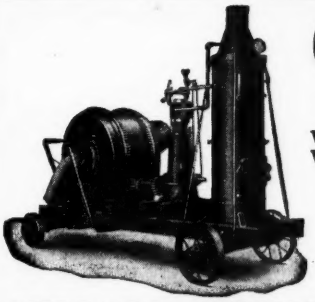

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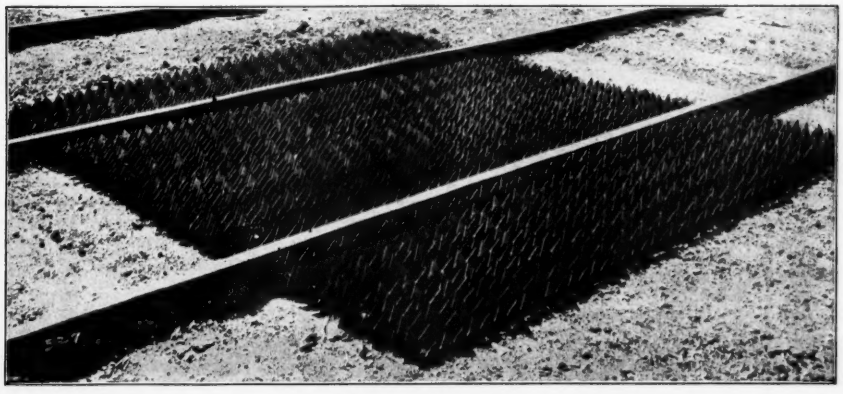

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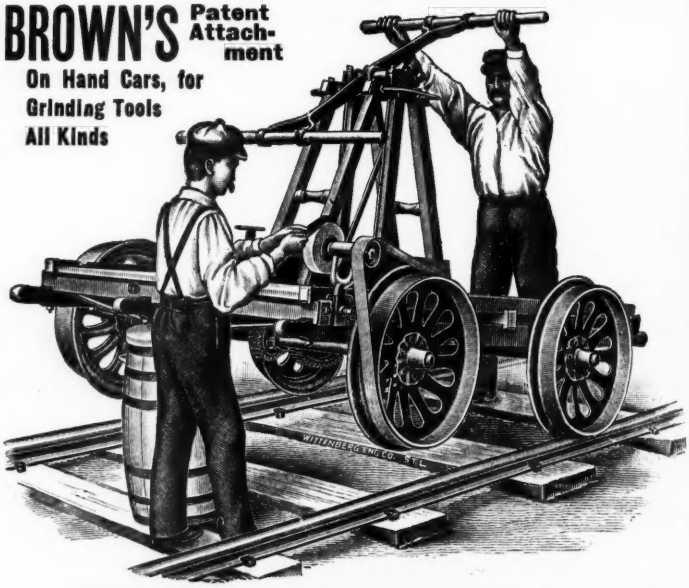

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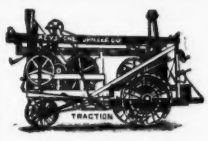

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Steam Shovels.
Atlantic Equipment Co., New York.
Torbert, A. C. & Co., Chicago.
Steel for Track Drills and Tools.
McInnes Steel Co., Corry, Pa.
Steel Ties.
Galt, Thomas A., Sterling, Ill.
Stock Guards.
Johnson Co., W. P., Chicago.
Standard Cattle Guard Co., Birmingham, Ala.
Stoves.
Buda Foundry & Mfg. Co., Chicago.
Structural Iron Paints.
Carey Mfg. Co., The Philip, Cincinnati, O.
St. Louis Surfacer & Paint Co., St. Louis.
Wadsworth-Howland Co., Chicago.
Surveying Instruments.
Hanna Mfg. Co., Troy, N. Y.
Kolesch & Co., New York.
Switch Indicator Bells.
Schwarze Electric Co., Adrian, Mich.
Switches and Switch Stands.
Buda Foundry & Mfg. Co., Chicago.
Indianapolis Switch & Frog Co., Springfield, O.
Tackle Blocks.
Patterson Co., W. W., Pittsburg, Pa.
Tanks and Tank Fixtures.
American Valve & Meter Co., Cincinnati.
Otto Gas Engine Works, Chicago.
Jackson Tool & Shovel Co., Montpelier, Ind.
Millers-Falls Co., New York.
Railway Supply Co., St. Louis.
Walters & Okell, Ft. Madison, Ia.
Tie Plates.
Adreon & Co., St. Louis, Mo.
Spencer Otis Co., Chicago.
Telephone Extension Bells.
Schwarze Electric Co., Adrian, Mich.
Ties, Steel.
Galt, Thomas A., Sterling, Ill.
Tool Steel.
McInnes Steel Co., Corry, Pa.
Track Drills.
Buda Foundry & Mfg. Co., Chicago.
Baldwin Steel Co., New York.
McInnes Steel Co., Corry, Pa.
Millers-Falls Co., New York.
Reed Co., Francis, Worcester, Mass.
Track Gauges and Level.
Buda Foundry & Mfg. Co., Chicago.
Railway Supply Co., St. Louis.
Track Jacks (See Jacks.)
Track Laying Machinery.
D. I. Holman Track Layer Co., Chicago.
Track Signs.
Adreon & Co., St. Louis.
Buda Foundry & Mfg. Co., Chicago.
Track Materials.
Indianapolis Switch & Frog Co., Springfield, O.
Track Tools.
Adreon & Co., St. Louis.
Buda Foundry & Mfg. Co., Chicago.
Turnbuckles.
Cleveland City Forge & Iron Co., Cleveland, O.
Valves.
American Valve & Meter Co., Cincinnati.
Varnishes.
Devoe, F. W., & Co., New York.
Velocipedes, Railway.
Buda Foundry & Mfg. Co., Chicago.
Railway Supply Co., St. Louis.
Vises.
Adreon & Co., St. Louis, Mo.
Dickinson, Paul, Chicago.
Water Columns.
American Valve & Meter Co., Cincinnati.
Water Proofing.
Standard Asphalt & Rubber Co., Chicago.
Water Softening Apparatus.
Kennicott Water Softener Co., Chicago.
Water Tanks.
Adreon & Co., St. Louis.
Railway Supply Co., St. Louis.
Wire Rope.
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Wrecking Cars.
Buda Foundry & Mfg. Co., Chicago.
Wrecking Frogs.
Railway Supply Co., St. Louis.

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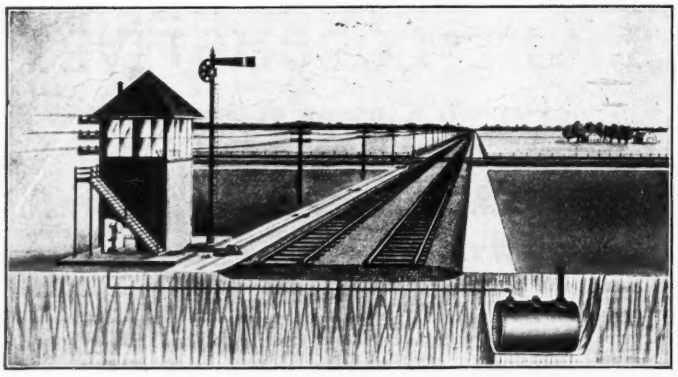

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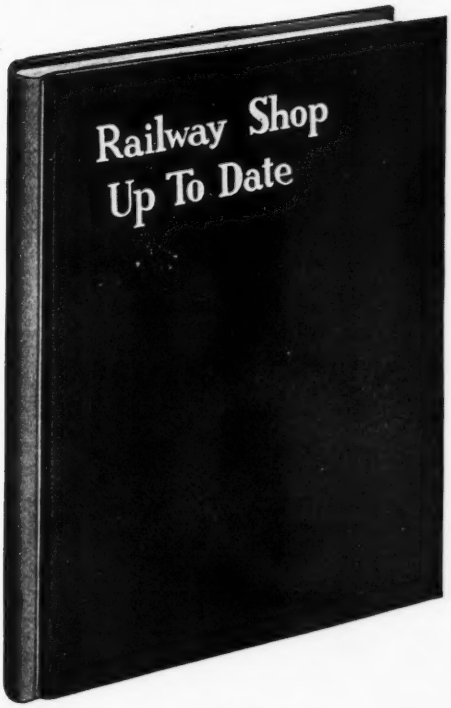

This is a book of nearly 250 pages 9x12 inches in size and filled from cover to cover with the practical every-day knowledge every railroad engineer ought to have. It has been carefully compiled from all that is known and has been written about the best and most representative railway shops in this country. Every large shop having up-to-date and valuable features, is described. Many of these shops are completely illustrated with cuts made from the drawings of the shops in the possession of the railroads. It is written in a clear and lucid style. It gives inside knowledge that is of inestimable advantage to every Engineer.

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BRUCE V. CRANDALL, President — WARREN EDWARDS, Vice-President
C. C. ZIMMERMAN, Secretary — MAHAM H. HAIG, Managing Editor
NORMAN F. REHM, Editor

Office of Publication: Security Building
Corner Madison St. and Fifth Ave.
CHICAGO
Telephone, Main 3185.

A Monthly Railway Journal

Devoted to the interests of railway engineering, maintenance of way, bridges and buildings.

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Entered as Second-Class Matter April 13, 1905, at the Post Office at Chicago, Illinois, Under the Act of Congress of March 3, 1879.

Vol. IV **Chicago, February, 1908** **No. 2**

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March Convention

THE next annual convention of the American Railway Engineering and Maintenance of Way Association will be held on March 17, 18 and 19, 1908, at Chicago. The results, which have been secured at past conventions, give assurance of valuable reports for the meeting next month. There is no doubt that there will be a large attendance, as most of the railroad engineers take a hand in the development and discussion of the reports.

The publication of a "Manual of Recommended Practice for Railway Engineering and Maintenance of Way" by this association is evidence to the effect that the work of the association is accomplished in a systematic manner and one which is productive of practical results. When it can be said that an association has succeeded in this manner, its continued prosperity is almost assured. Interest in the convention will not lag until there is no ground for improvement, and it may be safely said that the day when such may be the case is far in the future.

In another column a general idea of the reports to be submitted at the coming convention is given, and it will be noted at a glance that all of the subjects are of particular interest to the railroad engineer.

Cross-Ties and Timber Supply

STATISTICS, which have been compiled by the Forest Service, U. S. Geoolgical Survey, concerning the consumption of cross-ties by American railroads and the lumber cut of the United States, disclose some interesting facts. In 1906 the number of ties purchased by steam railroads exceeded that of 1905 by practically 30 per cent. The percentage of oak ties remained practically the same in 1906 as in 1905; the precentages of southern pines and hemlock decreased very little in 1906; the percentages of cedar, chestnut and tamarack decreased; and the percentages of Douglas fir and cypress increased. In connection with the above variation it is noted that the average value of oak ties decreased from 55 cents to 51 cents, while the average value of the other woods with the exception of chestnut, tamarack and hemlock increased. Of the woods, mentioned above, oak furnished about 44 per cent, southern pines about one-sixth, cedar about one-fifteenth and Douglas fir about one-fifteenth of the total number of ties.

The lumber cut of the United States increased in 1906, but the percentages of hardwood cut fell from 25 per cent. in 1899 to less than 19.5 per cent. of the total cut. The cut of oak which is the chief cross-tie wood fell off about 36.4 per cent. in the seven years.

The number of treated ties used by steam roads reached a total of 11,780,000, about 11.5 per cent. of the total number. With the decreasing supply of hardwoods, timber preservation has become more general and a number of treating plants have been established by railroad

companies. The use of treated ties may be expected to increase in the next few years and therefore it would seem that the oak tie should be somewhat less in demand.

American Roadway Practice

THE standard track sections, adopted by American railways, vary considerably in all dimensions, but this fact is due in the main to the conditions which exist on the various roads. Among the reasons for this variation may be noted the frequency and weight of traffic, the speed of trains and climatic conditions. It is acknowledged, however, that universal standards may be designed for several classes of track, which would require only slight changes, if any, to be applicable for all roads.

The width of roadbed for single track main line is between 18 and 20 feet, with few exceptions, and for double track between 30 and 33 feet. Such widths have proved very satisfactory and therefore have become very general. There are, however, localities, particularly the rocky, mountainous sections of the country, where it is not feasible to use greater than a 16 or 17-foot width. The width of roadbed on less important main lines and branch lines is somewhat smaller, varying between 16 and 18 feet. The standards of the American Railway Engineering and Maintenance of Way Association give three widths of roadbed, 20, 16 and 14 feet for the three classes of roadbed, but the practice on most roads is not to decrease the width of roadbed in such proportions. The initial cost of roadway construction and the cost of maintenance are lower with the greater width of roadbed, that is, a width between 18 to 20 feet.

The depth of ballast which is customary on main lines is 12 inches. It is the practice, however, on several roads to limit the amount of ballast beneath the ties to 7 or 8 inches, on account of the constituency of the soil. It has been recommended that the minimum amount of ballast should be 12 inches with substantial subsoil and that 18 inches would give best service, but it is not likely that roadways will be built of such proportions unless the cost of ballast is materially decreased and serious difficulties are encountered in maintaining roadway with the present 12 inches of ballast.

The slope of the roadbed depends upon the character of the subsoil and varies between a level surface and a slope of 12 to 1. An average slope would be about 24 to 1, or 5 inches on a 20-foot roadbed. On a substantial firm subsoil a slope to the roadbed is not deemed necessary to provide drainage, but very often a rise of 1 or 2 inches is given on an 18 to 20-foot roadway.

The slope of the ballast depends upon the material. With crushed rock ballast or slag it is customary to give a slope of 1.5 to 1, but there are cases where the slope is less than 1.5 to 1 and then again where it is as high as 2 to 1. With other materials the slope of ballast increases to 3 to 1, which slope is recommended as good practice.

The practice of sodding the roadbed up to the foot of ballast is becoming more general. The sod protects the subgrade and maintains the section against washouts. If sod were not used it would frequently be necessary to provide a heavy material to prevent the wearing away of the subgrade.

The distance between centers of double track is usually 13 feet. There are a few roads on which this distance exceeds 13 feet and very few on which it is less.

Drainage of the roadbed may be provided for with ditches and drains. The dimensions of ditch depend upon such conditions as climate, rainfall and extent of drainage area that must be handled. Where the water to be disposed of is very heavy, ditches are supplemented by drains. In cold climates the heaving of track is avoided to some extent by careful drainage and at the same time the use of shims may be abandoned.

Various opinions are advanced as to the best practice in the use of drains. Certain points in reference thereto are mentioned here. In the first place it is necessary to provide a good foundation for the tiling in order that it may not shift position, become clogged and therefore be of small value. The depth should be such that the subgrade will be thoroughly drained and therefore a depth of 2 or 3 feet below surface of subgrade should prove efficient. Drains are located beneath the center of ditch in a trench and covered completely with cinders. On double-track, cross-drains are used in cuts and these are placed on a slope at the surface of roadbed to carry the water to ditches or to drains parallel with the track.

Engineering Education

SINCE the day that engineering was recognized as a profession, the development of an efficient method of training has been in progress, and today this very subject is still one of vital importance. While the present system is an improved one, it is felt that there are many defects in it and the best results are not yet secured.

In the January issue of the Proceedings of the American Institute of Electrical Engineers, a paper by Mr. Chas. F. Scott is published on the subject of "The Best Engineering Education," which closes with a digest of the many Institute papers on the subject of education. While the paper refers particularly to electrical engineering, points are brought out which bear on engineering training in general. A few paragraphs are quoted, as follows:

"In general, instruction in engineering schools is of three varieties: practical or industrial, scientific and cultural.

"Practical or industrial studies are intended either as illustrations of scientific principles or as a direct preparation for business or professional life.

"Scientific studies are the foundation for the applications and make the latter possible.

"Cultural studies broaden the student's mental

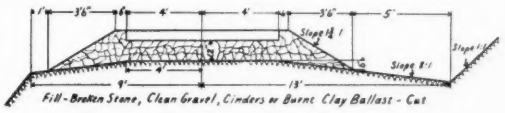
horizon, offset the narrowing effects of technical studies and prepare for activities which are not purely technical.

"The best engineering education is that which fits the individual student for his largest development and usefulness in the long run, not necessarily immediately after graduation. The problem, therefore, is to divide the four years spent in school among the three classes of studies in such preparation as will bring about the best results."

It is very often the case that a student has not specialized along the line which conforms to his work after graduation. He depends upon his general training and the studies, which are the fundamentals of engineering, to develop a more thorough knowledge for his later work. For this reason it is best to give more time to an understanding of the several branches of engineering than to train a student to be a specialist. The year or two years out of the four in which a student specializes at college gives only a fraction of the training obtained in the first year after graduation.

Standard Track Sections

THE variation in the design of track sections is indicated by the following detail information. For several of the railroads, one or more sections are here illustrated and supplemented with certain facts which are not evident from the special drawing.

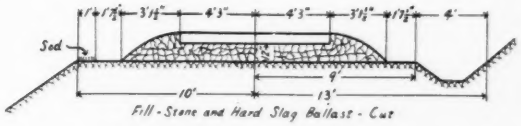


ATCHISON, TOPEKA & SANTA FE TRACK SECTION

ATCHISON, TOPEKA & SANTA FE RAILWAY.—This road has four track sections both for broken stone, clean gravel, cinders or burnt clay ballast, and for cementing gravel ballast, besides section for earth or material that will not drain and desert section. The roadbed has the same width for all ballast sections, but the depth of ballast decreases from 12 inches to 6 inches and the distance from tie to foot of ballast decreases from 4 feet to 2 feet 10 inches with the kind of ballast indicated in drawing and from 4 feet 4 inches to 2 feet with cementing gravel ballast. Where the fill is over 10 feet in height, the width of roadbed is 20 feet instead of 18 feet.

The slope of roadbed is the same for all sections, but the slope of ballast is not the same for cementing gravel as for the kind of ballast shown in section. The slope for cementing gravel has a 2 to 1 ratio from foot of ballast to a point 1 foot 4 inches from end of tie where the slope changes, the ballast becoming level with upper face of tie at a point 1 foot 9 inches from center of roadbed and being 3 inches from upper face of tie at end of tie.

With the 6x8-inch by 8-foot ties which are used, 3,400 cubic yards of ballast per mile are required in the section, illustrated herewith. The variation in cubic yards of ballast per mile for the several track sections with broken stone, clean gravel, cinders or burnt clay ballast is between 3,400 and 1,940 cubic yards per mile and with the cementing gravel ballast between 3,470 and 1,880 cubic yards per mile.



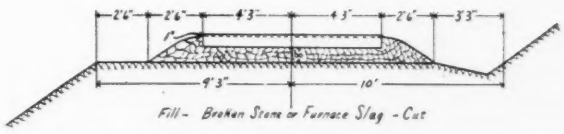
BALTIMORE & OHIO TRACK SECTION

BALTIMORE & OHIO RAILROAD.—There are three classes of track sections, A, B and C, both for stone or hard slag ballast and for gravel, cinder or granulated slag ballast. The width of roadbed on fills varies from 20 to 16 feet for the three classes, with 6 feet additional width in cuts, while the depth of ballast decreases from 12 to 6 inches. The distance from foot of ballast to end of tie varies between 3 feet 1½ inches (class A) and 2 feet 9 inches (class C) with stone and hard slag ballast and between 3 feet 9 inches and 2 feet 1¼ inches with gravel, cinder or granulated slag ballast.

With the latter kind of ballast the slope is made on practically a straight line from inside of rail to foot of ballast in cases where the ballast is very dirty or cements badly so that it does not drain properly.

Slopes of cuts are made generally as follows: Solid rock, ¼ to 1; loose rock, ½ to 1, and earth 1 to 1 and 1½ to 1. All earth slopes, cuts and fills are made 1½ to 1, except where it is advisable to alter to suit the character of material.

On curves the depth of ballast is maintained at 12 inches under lower rail for class A. On double track the distance between centers of track is 13 feet and width of roadbed is 33 feet on fills.



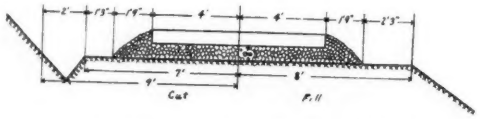
CENTRAL RAILROAD OF NEW JERSEY TRACK SECTION

CENTRAL RAILROAD OF NEW JERSEY.—Besides the section, shown herewith, for broken stone or furnace slag, there is one for engine ashes. The width of roadbed and depth of ballast is the same for both kinds of bal-

last. With the ballast of engine ashes the distance from end of tie to foot of ballast is 4 feet, the ballast being 1 inch from upper face of tie throughout length of tie and in cuts the roadbed slope is 10 to 1 from point beneath tie to bottom of ditch, 1 foot beyond foot of ballast.

The slope of embankments is 1½ to 1 and of cuts is as follows: Solid rock, ¼ to 1; broken stratified rock, ½ to 1; stiff earth, 1 to 1, and loose earth 1½ to 1. In wet cuts the width of roadbed is made 26 feet and 2 feet of berme is maintained on the subgrade, the depth of ditch being 6 inches or more.

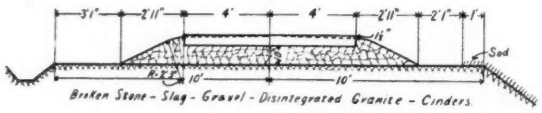
The minimum depth of ballast allowable under the ties is 4 inches, the standard being 8 inches. On curves the subgrade must slope so as to maintain these depths beneath lower rail. The width of roadbed for double track is 31 feet 6 inches on fills and 33 feet in cuts, these widths being the same for tracks on 12 or 13-foot centers. When such changes or repairs are in progress that admit of work being done at least cost, tracks are spread to 13 feet centers. In new construction engine ashes are used for ballast on all fills until they are thoroughly settled.



CENTRAL OF GEORGIA TRACK SECTION

CENTRAL OF GEORGIA RAILWAY.—The standard track section for the Henry Ellen branch is illustrated herewith. The standard section for the Greenville and Newman Railway of the same company differs from the above in the following particulars: There are only 5 inches of ballast under tie; the width of berme in cuts extends 2 feet 3 inches on subgrade from foot of ballast, and the ballast slopes from inside base of rail to foot of ballast.

The ends of cuts are flared, the center of ditch being moved gradually outward 10 feet from a point 30 feet from end of cut. The ties are 7x10 inches by 8 feet. The slopes of cuts and embankments are made to suit local conditions.



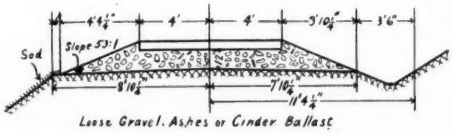
CHICAGO, ROCK ISLAND & PACIFIC TRACK SECTION

CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.—There are three classes of track sections designated by A, B and C, with widths of roadbed 20, 18 and 16 feet respectively. Under classes A and B, sections are given for broken stone, slag, gravel, disintegrated granite and cinders, for chats and sand and for earth. Under class C, sections for chats and sand are not included. For each kind of ballast, the sections under each class are given for 6, 7, 8, 9 and 10 inches of ballast under tie.

The section, shown herewith, requires 2,495 cubic yards of ballast per mile, the estimate of quantity being based on 3,200 ties, 6x8 inches by 8 feet, per mile. The cross section of ballast does not vary with width of roadbed, but only with depth of ballast. The cubic yards of ballast per mile, which are required for the sections of broken stone, slag, etc., vary between 2,495 and 1,644 cubic yards with ballast depths of 10 to 6 inches respectively. For chats and sand the variation is between 2,938 and 1,988 cubic yards with ballast depths of 10 to 6 inches respectively.

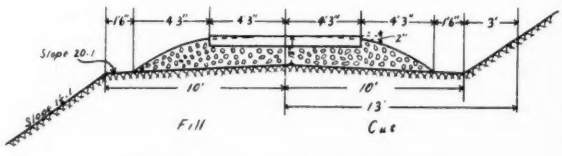
For double track, cubic yards of ballast per mile for broken stone, slag, etc., vary between 5,347 and 3,645 cubic yards under same conditions and for chats and sand between 5,852 and 4,055 cubic yards.

The section and area of ditch are governed by local conditions. The distance between centers of track is 13 feet.



CINCINNATI, HAMILTON & DAYTON TRACK SECTION

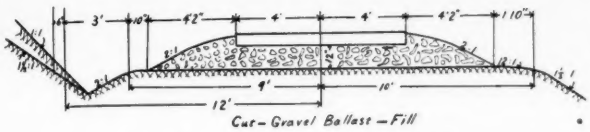
CINCINNATI, HAMILTON & DAYTON RAILWAY.—The standard track section for cementing gravel ballast is similar to the section for loose gravel, ashes or cinder ballast with the exception of ballast slope which in the case of cementing gravel is on a straight line from a point at end of tie and 4 inches below upper face of tie to foot of ballast 3 feet 10¼ inches from end of tie. The ties are 6x8 inches by 8 feet. The slope of subgrade is 2 inches in one-half the width of roadbed. It will be noted in the above drawing that 6 inches of sod are used on subgrade for embankments, but that there is no berme on subgrade for cuts. Below center of ditches 6-inch tile is placed 6 inches below surface of ditch or 14 inches below subgrade.



DELAWARE & HUDSON TRACK SECTION

DELAWARE & HUDSON COMPANY.—It will be noted that the depth of ballast is 12 inches below center of tie and the slope of subgrade is 6 inches in one-half the width of roadbed. The slope of cut or embankments is 1½ to 1.

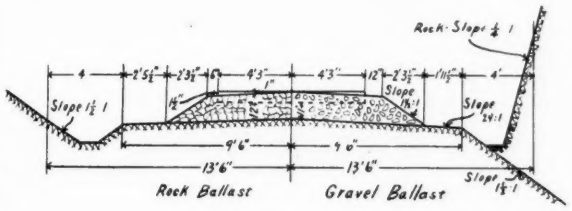
On double track roadbed the ballast at center of roadbed is 18 inches in depth and the slope of subgrade is 6 inches in 16 feet (one-half width of double track roadbed). The depth of ballast under center of tie is therefore about 14 inches for double track. The distance between centers of track is 12 feet.



DENVER & RIO GRANDE TRACK SECTION

DENVER & RIO GRANDE RAILROAD.—The width of roadbed is the same for the four standard roadbed sections with gravel ballast. The depth of ballast decreases from 12 to 6 inches and the distance from end of tie to foot of ballast decreases from 4 feet 2 inches to 3 feet 2 inches. The ties are 7 inches in depth.

The cubic yards of ballast per mile for 6, 8, 10 and 12 inches of ballast under the tie is 2,070, 2,550, 3,050 and 3,570 respectively for single track and 4,340, 5,305, 6 295 and 7,305 for double track.



ERIE TRACK SECTION

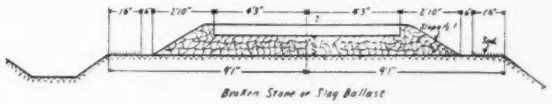
ERIE RAILROAD.—With rock and gravel ballast, for which track sections are shown herewith, it will be noted that the depth of ballast under center of tie is 11 inches and the subgrade has a slope of 4 inches in one-half width of roadbed. The depth of tie is 7 inches. The ballast area with rock ballast is 17.36 square feet and with gravel 19.64 square feet; the cubic yards of ballast per mile with rock are 3,152 and with gravel 3,596.

The slope of embankments is made 1½ to 1 and of cuts is made for rock ¼ to 1 least and 1½ to 1 for earth. Under rails there is a clearance of 1 inch between ballast and rail to allow for unbroken electric track circuit. Drain tile is used, where it is deemed necessary, and is laid on 1x6-inch plank 3 feet below bottom of ditch at center, being given a fall of at least 3 inches in 100 feet.

On single track curves the depth of ballast under lower rail is 12 inches, the ballast area for rock varies between 17.36 and 22.68 square feet and for gravel between 19.64 and 24.96 square feet, and the cubic yards of ballast per mile for rock varies between 3,152 and 4,192 and for gravel between 3,596 and 4,636. The greatest superelevation figured on is 8 inches and a special order is required for more than 6 inches superelevation.

For double track the subgrade has a slope of 6 inches in 20 feet (one-half width of roadbed), and the depth of ballast under inner rail is 12 inches. The distance between center of track is 13 feet. On tangent double track, the rock ballast area in square inches and cubic yards of rock ballast per mile are 37.5 and 7,092 respectively, and the gravel ballast area in square inches and cubic yards of gravel ballast per mile are 39.78 and 7,536 respectively.

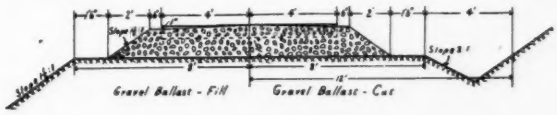
On double track curve the rock ballast area in square inches and cubic yards of rock ballast per mile vary from 37.5 to 45.97 and from 7,092 to 8,747 respectively, and the gravel ballast area in square inches and cubic yards of gravel ballast per mile vary from 39.78 to 48.25 and from 7,536 to 9,191 respectively. The inside rails on curves are on the same level plane.



GRAND RAPIDS & INDIANA TRACK SECTION

GRAND RAPIDS & INDIANA RAILWAY.—The width of standard roadbed for gravel or cinder ballast is the same as for slag or broken stone ballast, shown herewith. With the gravel or engine cinder ballast the depth of ballast under tie is 8 inches and the distance from end of tie to foot of ballast is 3 feet 4 inches, allowing of 18 inches sod. The slope of the latter ballast is on a curve of 25.18 foot radius from center of tie to foot of ballast. The depth of tie is 6 inches.

The slope of embankments and dry cuts is made 1½ to 1. For wet cuts, a ditch of variable width is used, the bottom of ditch being 12 inches below subgrade.



GREAT NORTHERN TRACK SECTION

GREAT NORTHERN RAILWAY.—The standard roadbed section for single track with gravel ballast is shown above. The depth of tie is 7 inches. Where a surplus of ballast is distributed the slope of 1½ to 1 is maintained approximately and the shoulder at top is increased from 6 inches, thus decreasing width of berme on subgrade.

The distance between centers of track is 15 feet. The depth of gravel between track is 10 inches, but where a passing track is lower than the main track, the gravel between tracks is kept level with bottom of tie of passing track.

HARRIMAN LINES TRACK SECTION

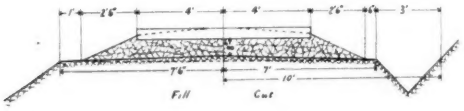
HARRIMAN LINES.—The standard track sections are common to all Harriman lines, which include among others the Oregon Railroad & Navigation Company lines, the Oregon Short Line, the Southern Pacific System and the Union Pacific Railway.

The standard track section with Sherman gravel, burnt clay or cinder ballast is shown above. The ties are 7x8 inches by 8 feet. The subgrade has a slope of 1½ inches in one-half width of roadbed. The slope for embankment or cut is 1½ to 1 with the exception of rock cuts, where slope is ¼ to 1 and the ditch is 18 inches wide at subgrade, 12 inches deep and 12 inches wide at bottom. The width of shoulder and roadbed may be increased up to 12 inches to suit variations in quality of gravel. With this ballast section, 2,573 cubic yards of ballast are required per mile.

The track section with broken stone or slag ballast differs in that the distance from end of tie to foot of ballast is 2 feet 6 inches, giving a width of roadbed on fills of 16 feet and in cuts of 21 feet. The ballast per mile required is 2,449 cubic yards.

Where ties are placed on earth, the width of roadbed on fills is 17 feet and in cuts is 21 feet. Where the ties are placed on sand or other permeable material through which water drains quickly, the width of roadbed on fills is 17 feet and in cuts is 19 feet 10½ inches. The latter section is used for particular localities in arid regions only when properly authorized.

The double track sections have detail dimensions common with single track. The distance between track centers is 13 feet and the subgrade slopes from center of roadbed, having the same fall as single track. On account of subgrade slope the depth of ballast under tie on the inside is slightly less than 8 inches. For the section with gravel, burnt clay or cinder ballast, 5,130 cubic yards of ballast are required per mile and for the section with Sherman gravel, broken stone or slag ballast 5,000 cubic yards are required.

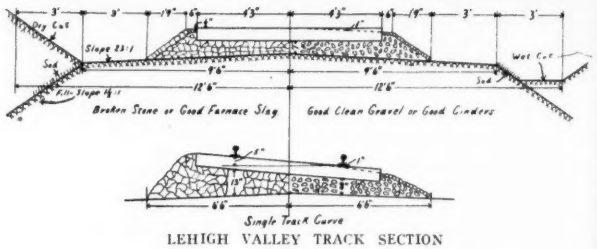


KANSAS CITY, MEXICO & ORIENT TRACK SECTION

KANSAS CITY, MEXICO & ORIENT RAILWAY OF TEXAS.—The standard track sections for earth embankment and cut are shown in the above drawing. At the foot of embankment the berme is 10 feet wide.

In rock cuts the width of roadbed at subgrade is 20 feet, crushed rock being used to a depth of 12 inches below subgrade. The width of ditch at subgrade is 3 feet and at bottom is 1 foot 1½ inches, the bottom being 1 foot 6 inches below subgrade. The side slope of cut is ¼ to 1.

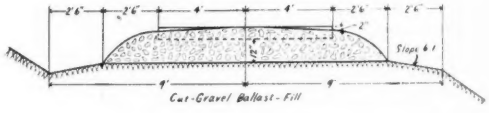
LEHIGH VALLEY RAILROAD.—The track sections for the several kinds of ballast are the same with the exception of ballast slopes. For broken stone or good furnace slag ballast and for good, clean gravel or good cinder ballast the slopes are shown in the accompanying drawing. With poor gravel or clay, the ballast slopes from center of roadbed to a point a few inches beyond rail so as to give 1 inch clearance between rail and ballast and then on a straight line to foot of ballast 3 feet beyond end of tie. The subgrade has a slope of 5 inches in 9 feet 6 inches in all cases.



LEHIGH VALLEY TRACK SECTION

On single track curves the depth of ballast is shown in the above drawing for a superelevation of 5 inches, the distance from center of roadbed to foot of ballast being 6 feet 6 inches as on tangent single track.

The distance between centers of track is 13 feet. The slope of subgrade from center of double track roadbed is 5 inches in 16 feet.



NEW YORK, NEW HAVEN & HARTFORD TRACK SECTION

NEW YORK, NEW HAVEN & HARTFORD RAILROAD.—The track section with gravel ballast is shown in the above drawing. The distance between centers of track is 12 feet. For double track the subgrade slopes from center of roadbed 2 inches in 12 feet 6 inches and for four track it slopes from center 3 inches in 24 feet 6 inches. With stone ballast the ballast is level with tie between tracks and the slope is 1 to 1 from a point 12 inches from end of tie to foot of ballast.

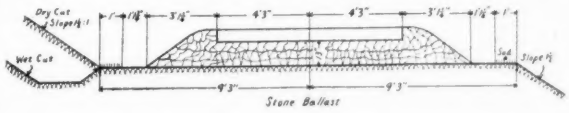
PERE MARQUETTE TRACK SECTION

PERE MARQUETTE RAILROAD.—The standard track sections are divided into three classes for main line, less important main line and branches. The width of roadbed decreases for the several classes from 18 to 14 feet on fills and the depth of ballast from 12 to 6 inches. If fills are over 8 feet the width of roadbed is increased 2 feet for each class and it may also be increased on account of material or to provide necessary drainage. The width of roadbed in cuts is 6 feet greater than on fills. The depths of ballast given above are for sand subsoil and are decreased 1½ inches at center of roadbed, if subsoil is clay or loam. The distance from end of tie to foot of ballast decreases from 4 feet to 2 feet 4 inches.

On double track the roadbed is 32 feet wide on fills.

with a distance of 14 feet between centers of track. The subgrade is level with sand subsoil and has a slope of 1½ inches in 16 feet with clay or loam subsoil. The width of roadbed is 2 feet greater on fills over 8 feet.

PHILADELPHIA & READING RAILWAY.—The standard track sections are simliar to those of the Central Railroad of New Jersey, which have already been described.



PENN. LINES W. OF P. TRACK SECTION

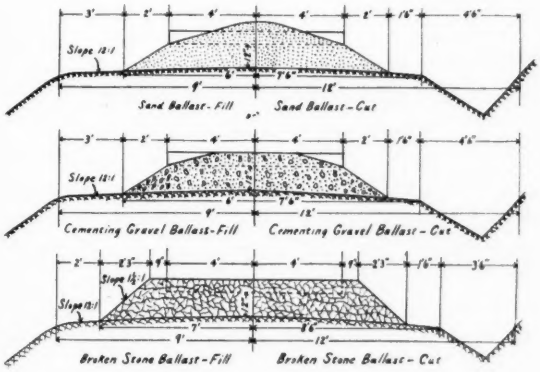
PENNSYLVANIA LINES WEST OF PITTSBURG.—There are two classes of track which differ mainly in depth of ballast and width of roadbed. The section for class A track with rock ballast is shown above, but a proposed revision to change slope of ballast to 1½ to 1 is not indicated. Ties are 7x9 inches by 9 feet.

On Class A track with gravel or engine cinder ballast, the depth of ballast and width of roadbed are the same as with rock ballast, but the slope of ballast is from upper face of tie, about 14 inches from center to foot of ballast, 4 feet 3 inches from end of tie, on a curve of 22.59 foot radius. The berme of width 12 inches is covered with sod.

On Class B track with gravel or engine cinder ballast, the depth of ballast is 8 inches, the width of roadbed is 17 feet and the distance from end of tie to foot of ballast is 3 feet 3 inches, but the slope is same as for gravel ballast on Class A track.

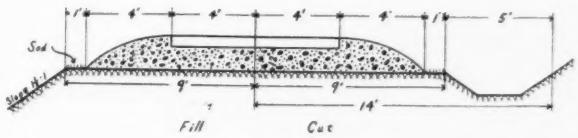
The size of ditch is governed by local conditions depending on quantity of water and drainage. The slope of embankment or cut is made 1½ to 1.

The distance between centers of track is 13 feet and the ballast between ties is level with upper face of tie. The inside rails on curves are on same elevation.



ST. LOUIS SOUTHWESTERN TRACK SECTIONS.

ST. LOUIS SOUTHWESTERN RAILWAY.—The width of roadbed and depth of ballast are the same for all track sections, three of which are shown in the above drawing. The track section with cinder or fine gravel ballast is same as that for broken stone ballast, with several exceptions outlined as follows: The width of ballast shoulder is 6 inches instead of 9 inches; the width of berme on fills is 2 feet 3 inches instead of 2 feet, and the width of ditch is 3 feet 9 inches instead of 3 feet 6 inches. In the track section for ties laid on earth, the earth rises above tie between rails. It will be noted that the slope of subgrade is 1 inch in 12 inches for all sections.



WABASH TRACK SECTION

WABASH RAILROAD.—There are two classes of track of which Class A is shown herewith. On Class B track the width of roadbed on fills is 16 feet and in cuts is 24 feet, with ditch 4 feet in width, the depth of ballast is 8 inches under tie and distance from end of tie to foot of ballast is 3 feet.

The distance between centers of track is 13 feet and the ballast between ties is maintained at level of tie.

The quantities of ballast per lineal foot of track are as follows: Class A, single track, 0.70 cubic yards; Class B, single track, 0.48 cubic yards; Class A, double track, 1.37 cubic inches, and Class B, double track, 0.98 cubic inches.

TABLE I—CLASS A.

RAILROAD	Division of class A	Width of Roadbed (feet)	Distance from tie to foot of ballast (feet)	Depth of Ballast (inches)	Length and depth of tie (feet-inches)	Distance between track centers (feet)
A. T. & S. F.	2-3	18	4	12	8-6	..
B. & O.	2	20	3 3/24	12	8½-6	13
C. R. R. of N. J.	2	18 1/2	2 1/2	8	8½-7	13
Cent. of G.	2	16	1 3/4	8	8-7	..
C. & A.	2	18	2 5/6	12	8-6	13
C. & N-W.	2	20	3	12	8-6	13
C. ,B. & Q.	2	17	2 1/4	8	8-6	..
C., R. I. & P.	2	20	2 11/12	10	8-6	13
C., St. P., M. & O.	2	19	3	12	8-6	..
C., H. & D.	3	17 17/24	4 17/48	12	8-6	..
D. & H.	..	20	4 1/4	11	8½-7	12
D. & R. I.	3	20	4 1/6	12	8-7	15
Erie	2	19	2 19/24	11	8½-7	13
G. R. & I.	2	18 1/6	2 5/6	10	8½-6	..
G. N.	3	16	2 1/2	10	8-7	15
Harriman Lines	3	17	3	8	8-7	13
Illinois Central	1-2	20	3 3/4	12	8-6	14
K. C., M. & O.	..	15	2 1/2	8	8-6	14
Lehigh Valley	2	19	2 1/4	7	8½-7	13
Mo. Pac.	..	..	2	6	8-6	..
N. Y., N. H. & H.	3	18	2 1/2	12	8-6	12
N. Y. C. & H. R.	3	18	3 17/48	12	8-6	12
Pere Marquette	1	18	4	12	8-6	14
Phila. & Reading	2	18 1/2	2 1/2	8	8½-7	13
P. L. W. of P.	2	19	3 1/8	13	8½-7	13
St. L. S-W.	2	18	3	12	8-6	..
Wabash	.	18	4	12	8-6	13

TABLE II—CLASS B.

RAILROAD	Division of class B	Width of Road-bed (feet)	Distance from tie to foot of ballast (feet)	Depth of Ballast (inches)	Length and depth of tie (feet-inches)	Distance between track center (feet)
A. T. & S. F.	2-3	18	3 7/12	10	8-6	..
B. & O.	2	18	2 11/12	9	8½-7	..
C. R. R. of N. J.	3	18 1/2	4	8	8½-7	13
Cent. of G.	..	16	1 3/4	5	8½-7	..
C., R. I. & P.	2	18	2 7/12	8	8-6	13
C., H. & D.	4	17 17/24	4 17/48	12	8-6	..
D. & R. I.	3	20	3 5/6	10	8-7	15
Erie	3	19	3 7/24	11	8½-7	13
G. R. & I.	3	18 1/6	3 1/3	8	8½-7	..
Harriman Lines	2	16	2 1/2	8	8-7	13
Illinois Central	1-3	16	3 1/2	10	8-6	..
Lehigh Valley	2	19	2 1/4	7	8½-7	13
Pere Marquette	1	16	3 1/6	9	8-6	..
Phila. & Reading	3	18 1/2	4	8	8½-7	13
P. L. W. of P.	3	17	3 1/4	8	8½-7	13
St. L. S-W.	4	18	2	12	8-6	..
Wabash	..	16	3	8	8-6	13

TABLE III—CLASS C.

RAILROAD	Division of class C	Width of Road-bed (feet)	Distance from tie to foot of ballast (feet)	Depth of Ballast (inches)	Length and depth of tie (feet inches)	Distance between track centers (feet)
A., T. & S. F.	3	18	3 5/6	8	8-6	..
B. & O.	2	16	2 5/48	6	8½-7	..
C., R. I. & P.	2	16	2 1/4	6	8-6	13
D. & R. I.	2	20	3 1/2	8	8-7	15
Illinois Central	1-2	16	2 3/4	8	8-6	..
Pere Marquette	1	14	2 1/3	6	8-6	..
St. L. S-W.	4	18	2	12	8-6	..

The accompanying tables, giving certain dimensions of standard track sections, are for three classes of track, A, B and C, which are subdivided as follows:

Class A.

(1) Important Main Line.
(2) Crushed Rock and Slag.
(3) Gravel, Cinders, Chats, etc.

Class B.

(1) Less Important Main Line.
(2) Crushed Rock and Slag.
(3) Gravel, Cinders, Chats, etc.
(4) Cementing Gravel and Chert.

Class C.

(1) Branch Lines.
(2) Gravel, Cinders, Chats, etc.
(3) Cementing Gravel and Chert.
(4) Poor Gravel, Sand, Clay, etc.

It will be understood that all the track sections are not included in the preceding tables. Only the sections which indicate best the practice of the railroad were given. The division and subdivision was made to agree with the above form where it was possible, but in some cases it was effected at the discretion of the writer.

Identification of Woods

IT is doubtful if any of the laboratories maintained by the government for scientific research are more unique in character, and yet bear promise of more important results, than one which has just been established in Washington by the United States Forest Service for investigating the structure of commercially important woods.

Laymen will not understand the significance of the proposed investigations carried on in this laboratory so quickly as architects, builders and other wood users, who in these days of growing scarcity of the more valuable woods are seriously perplexed in identifying substitutes. Mistakes of this kind in identification have, in the last few years, in several instances, meant the loss of thousands of dollars, and many embarrassing law suits.

Nearly any user of lumber can recognize, and name off-hand, all the usual trees of the forest when he sees them growing, and not much difficulty is encountered in identifying the common kind of lumber in a mill yard because he knows the few trees from which the yard lumber comes. But common kinds are growing scarce, and woods not often cut heretofore, are appearing in the markets. The most experienced men are sometimes puzzled when they try to identify them, and persons with less experience have still more trouble. Is a certain wood gum or elm? Is another cucumber, linn, or poplar? Is a stick sugar maple or red maple? Doubts may arise whether a piece is hemlock or spruce, or whether it is lodgepole pine or fir, or whether a shingle is cypress or cedar. A dealer may buy red oak and suspect that he is getting something else. There are thirty or more important species of oak. The best lumber dealer might not know which is which in the lumber pile, or if he knows, he might not know how to prove it.

Many of these woods look alike, even to the trained eye of the millman or the builder, and yet they are widely different in value for certain purposes, and it is of the greatest importance to be able to distinguish them quickly and certainly. Again, a new wood may come to a man's notice for the first time, and it may be necessary for him to decide what it is and what it is worth.

The government has been helping individual lumber users for some time, but the facilities have not been near so complete as they are now. It is to meet such needs and answer such questions, that the Forest Service has established the laboratory, and placed it in charge of a trained dendrologist. Architects, lumbermen, manufacturers and makers of woodware are already sending in samples of wood for identification, and asking if there are not some structural characters by means of which such woods may be conveniently separated for relative species having greater or less value for some specific purpose.

The laboratory will investigate in a practical way. The structure of the woods, sections lengthwise and crosswise, will be studied so as to separate by structure alone the various species of a genus. Analytical keys to the trees of each group will be worked out. These will be

based on the arrangement and character of the pores discernible to the naked eye, or by a hand lens.

The results will be published from time to time with good illustrations and placed at the disposal of lumber users. After all the important groups of wood, such as oaks, pines and firs, have been studied and the results published separately, the several monographs will be collected and published in one volume.

A work of this character has long been in demand by architects, builders and other users of lumber. It will, in most cases, enable even a non-technically trained man to determine quite readily the wood he deals with by means of an ordinary hand lens and by comparing the wood in question with the photographs of cross and long sections given in these monographs.

Compression Members for Railway Bridges

VALUABLE data on wrought iron and steel compression members was presented in a recent issue of the Engineering News in an article by Mr. C. P. Buchanan, assistant engineer of bridges, Pennsylvania Lines West of Pittsburg. The tests were made on full size compression members by the engineering department of the Pittsburg, Cincinnati, Chicago & St. Louis Railway throughout a period of twenty years. The object was to secure a column stronger in details than in body.

Nineteen tests were made for which complete data, including detail construction of member, tables of loads with compression and deflection, stress diagrams and views of members after failure, are included in the article.

These tests show that the actual elastic limit varied between 45 and 83 per cent. of the ultimate strength, the average being 59.7 per cent. The actual crippling strength varied between 54 and 94 per cent. of the maximum with an average of 71.8 per cent. The maximum strength varied between 23,290 pounds and 34,270 pounds per square inch. The above figures cover both wrought iron and steel. Tests of material used in the members gave an average elastic limit of 30,700 pounds for wrought iron and 39,900 pounds for steel.

A consideration of the data presented would indicate that the maximum allowable stress in steel columns should not exceed 60 per cent. of the elastic limit of the material in tension. In this case the stresses would vary between 20,000 and 24,000 pounds per square inch if no allowances were made for column reduction, uncertainties, imperfections, etc.

Failure in columns 1 to 4 resulted from the buckling of the member as a whole without marked local cuppling; in columns 5 to 8 failure occurred in end detail; in column 9 the outstanding legs of angles buckled near center; in columns 10 to 12 failure occurred in end detail, and in columns 13 to 19 failure resulted from buckling at various points.

Change in Panama Canal Plans

THE special report of the chairman of the commission to the Secretary of War, which recommended locks and dams at Miraflores instead of at La Boca, was approved by the President. The report as given in "The Canal Record," is as follows:

The adopted plan for the building of the Panama canal contemplates the formation of a lake on the Pacific side by the construction of three earth dams (Sosa-Corozal, Sosa-San Juan and Corozal-Diablo), the differences of level between the lake and the Pacific being overcome by a flight of two locks projecting into the Pacific on the west side of Sosa Hill.

The board of consulting engineers that accompanied you to the isthmus in April last, inspected the sites of the dams, as finally located, with the view to outlining a detailed description of the preparation of the foundations for the structures to be erected, reporting thereon as follows:

The borings showed so-called mud in the swampy portion, having a depth of 8 or 10 ft. This material is firmer than we had expected, and at the time of our visit, about two days after it had been flooded by spring tides, it could be walked on in most places. * * *

For the dam construction * * * we do not think it will be necessary to remove the soft material at either of these places (Sosa-Corozal, Sosa-San Juan). The very softest material will either be displaced or consolidated by the material disposed on it. We do not think the amount displaced beneath the impervious portion of the embankment will be great, and if compressed in place the material will be impervious.

As regards the character of the material that should compose the body of the structure, the same board reported:

For the Sosa-Corozal and La Boca dams the bottom width of the impervious portion should not be less than would result from a top width of 80 to 100 feet at 15 to 20 feet above the water level in the lake, with slopes not steeper than 1 on 4 to 1 on 5. The resulting width at sea level would be 640 feet or more. The comparatively small cross section suggested for the impervious portion of each of the Pacific dams is permissible only if it is reinforced by wide and heavy rock embankments on both sides. * * * On account of the nature of the bottom on which this rock fill will be deposited for the dams on the Pacific side, it should extend a long distance outside of the impervious portion in accordance with the principle adopted for the La Boca dam by the minority of the board of consulting engineers in 1905-6, of spreading the base on soft bottom so that the change in weight imposed on the foundations from the toe towards the crown will be gradual. This protection at the Sosa-Corozal and La Boca dams may be given great width with economy since they will afford convenient dumps for the Culebra material.

To construct the dams in accordance with these views, trestles were built along the toes of the Sosa-Corozal dam, from which to dump material from the Culebra Cut. The trestles failed, after the dumping of the materials from them began, and the material overlying the rock moved laterally carrying the superimposed mass

with it, the dumps flattening out until the side slopes were about 1 on 12 and even less. In places this lateral motion continued for two weeks after dumping had stopped. The ground on either side of and at some distance from the dump was forced up forming mounds of mud, the crests of which gradually approached the level of the top of the dump proper. After an equilibrium was established between the dump and the adjacent mounds, the hump or wave would again move out when the track was shifted towards it, accompanied by a sudden vertical settling of the track of six to ten feet when loaded trains were applied. It was thought that if the trestle were lower better results might obtain, but with the west trestle only 8 feet above the surface of the ground and the piles driven to rock, similar failures followed.

When the difficulties on the east trestle developed, an investigation, by boring and test pits, was made to determine the character of the material overlying the rock. It was found to be for the greater part an unctuous blue clay without grit, possessing but little supporting power, instead of stiff clay, as indicated on existing profiles.

The investigations clearly demonstrate that the construction of dams which would remain in place after the lake is filled can be accomplished only by the removal of all material overlying the rock, and, after preparation of the rock surface, by building the dams of selected material. The depth to which the material will have to be removed is from 10 to 70 feet, and suitable material for dam construction will have to be transported to the site. Investigations of the foundations of the Sosa-San Juan dam show that the material is the same; the difficulties to be encountered will be greater because of the river.

It is estimated that the cost of building the two dams, following the plan that the investigations and work done indicate as necessary, will be about $11,573,800. The estimate submitted by the minority of the board of consulting engineers for these dams is $4,314,000, a difference of $7,259,800.

As this difference to secure stability is excessive, an examination of the canal route from Pedro Miguel to the Pacific was undertaken to ascertain if more suitable places for the locks and dams could be found. In making these examinations care was taken to secure samples of the materials to be encountered at various depths and cores procured of the rock. A careful study was made of all data obtained and four possible projects present themselves for constructing that portion of the canal extending from the south end of the Culebra Cut to deep water in the Pacific ocean.

First project—This is the present project and consists of one lock at Pedro Miguel and two at La Boca, with dams of suitable material on rock. The estimates submitted by the board of consulting engineers are corrected to conform to methods, quantities and unit prices that additional information and experience show will give more nearly the actual cost of the work. The project provides a 500-foot channel from Pedro Miguel to Miraflores, a 1,000-foot channel through Sosa lake to La Boca, and a 500-foot channel from La Boca locks to deep water.

Second project—Two locks at Pedro Miguel and one at Miraflores, with a 500-foot channel through the lake from Pedro Miguel to Miraflores, and a 500-foot channel from Miraflores to deep water in the Pacific ocean.

Third project—One lock at Pedro Miguel and two at Miraflores with a 500-foot channel through the lake from Pedro Miguel to Miraflores, and a 500-foot channel from Miraflores locks to deep water in the Pacific ocean.

In this and in project No. 2 provision is made for diverting the waters of the Rio Grande and the Corundi and the Cocoli rivers, as well as for a channel of uniform width to the sea, having no connection with any other tidal basin; as a consequence the currents in the channel will result only from the tidal flow and will not attain a velocity as great as one foot a second, which will not interfere with navigation.

Fourth project—One lock at Pedro Miguel, one at Miraflores and one at La Boca, with 500-foot channels between locks and to deep water in the Pacific.

In each case locks and dams are on rock foundations. Assuming that inverts are used, the total costs of the various projects are as follows:

Project No. 1	$58,395,540
Project No. 2	58,467,048
Project No. 3	50,927,268
Project No. 4	66,690,618

From the foregoing it is seen that Project No. 3, one lock at Pedro Miguel and two at Miraflores, is the most economical. It has the advantage over the present project in that the dams of lower height, less length, and resting on rock comparatively near the surface can be more easily constructed, and completed at an earlier date. It is to be preferred to Project No. 1 by reason of the fact that the location of the locks secures them against all possibility of distant bombardment and affords them greater security against gunboat or torpedo boat attack.

The commission unanimously recommends the adoption of Project No. 3 and its substitution for the existing project.

The above report was addressed to the Honorable Wm. H. Taft, Secretary of War, and signed by Geo. W. Goethals, chairman.

Fence posts of many kinds of cheap woods which ordinarily would soon decay if set in the ground can be made to last for twenty years by a simple treatment with creosote. Most of the so-called "inferior" woods are well adapted to the treatment, and this is especially true of cottonwood, aspen, willow, sycamore, low-grade pines, and some of the gums. When properly treated, these woods outlast untreated cedar and oak, which are becoming too scarce and too much in demand for other uses to allow of their meeting the demand for fence posts.

American Railway Engineering and Maintenance of Way Association

THE ninth annual convention of the American Railway Engineering and Maintenance of Way Association will be held at the Auditorium Hotel, Chicago, on March 17, 18 and 19, 1908.

It is the practice of this organization to appoint committees immediately after each annual convention, the titles of the respective committees being Roadway, Ballasting, Ties, Rail, Track, Wooden Bridges and Trestles, Buildings, Masonry, Signs, Fences, Crossings and Cattle Guards, Signaling and Interlocking, Records, Reports and Accounts, Uniform Rules, Water Service, Yards and Terminals, Iron and Steel Structures, Economics of Railway Location, Classification of Track, and Uniform General Contract Forms. To each of the foregoing committees is assigned certain sub-divisions of the general subject coming within its special province, for report to the following annual convention.

The several committees are expected to thoroughly investigate the subjects assigned, by the collection of data pertaining to the matter in hand, and after full consideration of the information available, to submit to the Association a report embodying their conclusions and recommendations for adoption by the Association as good practice.

This method of working has been productive of excellent results, as is shown by the Manual of Recommended Practice for Railway Engineering and Maintenance of Way, published in 1907.

The reports to come before the ensuing annual convention are the result of painstaking labor on the part of the several committees, and will undoubtedly result in valuable discussion on the floor of the meeting.

The Committee on Roadway has had under consideration during the past year the subject of track elevation and depression inside cities, and also the practical work of grade and curve improvements outside cities, and presents in addition to its conclusions, a summary of replies to its inquiries on track elevation and depression.

The Ballasting Committee presents a brief report on the subject of ballast.

The Tie Committee will have a valuable report on the future policy of railroads with reference to sources of tie supply; a compilation of answers as to causes of failure of ties; also additional information on the live subject of preservation, together with a list of tie treating plants in the United States.

The Committee on Rail submits a series of blank forms for use in reporting rail failures.

The Track Committee presents a report on turnouts and turnout material, including the recommended types of switch stands, switch points, frogs, guard rails and throat clearance; a report on the tiling of wet cuts and the curing of slides; a report on the subject of widening of gage on curves, the latter subject being a joint recommendation of the Track Committee and a sub-committee of the Master Mechanics Association.

Locomotive coaling stations and the use of reinforced concrete for roundhouses form the main features of the report on Buildings. Other subjects dealt with in this report are the best method of smoke removal, ventilation and heating of roundhouses; the use of movable or fixel cranes for facilitating locomotive repairs in roundhouses; arrangement of windows and roof lights and proper ratio of light to floor surface in roundhouses.

The Committee on Wooden Bridges and Trestles submits a valuable report on the cost of construction, maintenance and life of ballast floor trestles of the different types now in use, with designs explanatory of the types considered; an extension of the list of recommended safe unit stresses for timber; a report on the methods of preserving structural timber, their cost and efficiency, and their influence on the strength of timber; a report on the question of a standard specification for structural timbers.

The Masonry Committee presents for final adoption the specifications for Stone Masonry, and in addition a report on the most economical size or combination of sizes for stone to be used in stone concrete, as applied to the different classes of railroad work. This committee has also in preparation an exceedingly valuable report on typical standard designs now in use for masonry culverts, both stone and concrete. This last-mentioned subject will be published after the convention in a special bulletin.

The subjects of snow fences, snow sheds and other means to prevent snow accumulating and best methods of clearing tracks and snow removal form the principal feature of the report on Signs, Fences, Crossings and Cattle-Guards.

The report on Signaling and Interlocking, presented for the ensuing convention, will be of especial interest not only to engineers, but to transportation officials as well. The committee has prepared a valuable report on the subject of a comprehensive system of signaling, and in addition presents as an appendix three interesting papers by members of the committee, dealing with the matter of Signaling.

The Committee on Records, Reports and Accounts presents a report on the subject of Individual Ledger Accounts and on the proper system of right-of-way and track maps.

Rules Governing Supervisors of Signals is the subject of the report on Uniform Rules. Rules Governing Supervisors of Track and Structures have already been adopted by the association in previous years.

The Water Service Committee has taken for its subject this year a revision of matters previously adopted by the association, and the committee submits a

condensation of the recommendations heretofore approved by the association.

The Committee on Yards and Terminals presents an interesting and comprehensive report on the subject of Hump Yards. The report contains a large number of diagrams showing the practice of various companies in reference to hump yards.

Under the auspices of the Committee on Iron and Steel Structure, a series of experiments have been made during the past year on the effect of moving loads on railroad bridges. The tests have been made with twelve instruments specially constructed for this purpose, and the work of making the experiments has been performed by a number of experts, under direction of the sub-committee above-named. A preliminary report is presented on the tests already made, and forms a valuable contribution to the literature on this mooted question. The experiments referred to have been made on the Illinois Central, Rock Island, Burlington and Nickel Plate roads. In addition to this feature, the committee's report contains a discussion on the care of existing bridges—inspection, methods of field work and records of inspection; also a report upon the classification of bridges as to safe carrying capacity.

As an appendix to this report is to be considered an interesting and instructive paper by Mr. A. F. Robinson, Bridge Engineer, Atchison, Topeka & Santa Fe Railway System, on "Open versus Ballast Floor Bridges," giving the results of the use of ballast floor structures on the Santa Fe System.

The Committee on Economics of Railway Location presented an exhaustive report on the matter of Train Resistance in 1907. A report of progress will be presented this year, and in addition, as an appendix, an interesting paper by Mr. A. K. Shurtleff, entitled "Time as an Element to be Considered in Grade Reductions."

The convention will open in the Banquet Hall of the Auditorium Hotel on the morning of March 17th. Both morning and afternoon sessions will be held; an evening session will be held on the night of the first day of the convention. The annual dinner will be given on the night of the second day.

Retaining Walls for Track Elevation

TWO designs of retaining walls were used in the track elevation work on the Delaware, Lackawanna & Western Railroad. For elevations from 12 to 24 feet a buttressed wall was used and for elevations under 12 feet an L-section without buttresses was used. This work was described in a recent issue of the Engineering Record.

The walls are 2 feet thick and the bases 2 feet 6 inches thick. The width of base for the buttressed type is one-half the height of the wall above top of base plus 2 feet. The pressures due to moving loads on the tracks were computed for Cooper's E50 loading and earth pressures against the walls were figured from the formulas in Church's Mechanics, the weight of earth being taken at 100 pounds per cubic foot. The stresses in the steel were held under 16,000 pounds per square inch and in the concrete under 500 pounds.

The reinforcement of the buttressed section is as follows: At a distance of 2½ inches from front face of wall, are placed ⅝ inch horizontal bars on 18-inch centers for the first 6 feet from top, on 12-inch centers for next 6 feet, on 9-inch centers for next 5 feet 3 inches and on 6-inch centers for remainder of distance and ½ inch vertical bars on 2-feet centers; near the back face of wall five ½ inch bars are placed on 18-inch centers from top of wall down; two tie-rods are placed horizontally into buttress from every third horizontal face bar; eight 1¼-inch bars are placed 3½ inches from face of buttress but only four extend the entire length.

The buttresses are 2 feet wide and are placed 12 feet 6 inches on centers. Expansion joints were placed every 50 feet which constituted a day's work.

The concrete was a 1:3:6 mixture made with gravel. The reinforcement for L-section walls is similar to that for the buttressed section.

Signaling on Electrified Roads

IN a paper presented before the American Institute of Electrical Engineers, Mr. L. Frederic Howard discussed the subject of signaling on electrified roads. The different track circuit systems in operation on electrified roads were described and the simpler form of track circuit system in use on steam roads was discussed. The paper was concluded with the following discussion of which extracts are given.

By the use of an alternating signaling current, we have an increase in the apparent resistance of the rails due partly to skin effect and partly to magnetic induction. This increase is of course a function of the frequency.

We have also introduced an artificial apparent conductance between the rails in the inductive bonds, and they, together with the relays, introduce another inductive component.

The increase in the apparent resistance of the rails means, of course, higher voltage at the source of supply for the track circuit, and consequently more power. On account of the higher impedance of the rails and the consequently higher voltage required at the source of the supply of the track circuit, other things being equal, a given shunt applied to the rail at the relay will produce a larger percentage change of voltage across the terminals of the relay.

On the other hand, where relays with a single winding are used, and there is leakage around an insulation joint from an adjacent block, a train at a given

distance beyond the relay has less shunting effect on the relay, and there is greater danger of getting a clear signal with a train in the block, than with the direct-current track circuit.

This danger may be diminished in various ways, among which are adjustment of the voltage of the source of current supply to the track circuit, so that to the relay is given just enough energy to operate satisfactorily under the worst weather conditions, by arrangement of the track circuit apparatus or by the use of two element relays with the rails of adjacent blocks of opposite polarity.

When two-element relays are used, they should be as free as possible from any tendency to close the contacts because of repulsion or induction motor effects, caused by normal or accidental short-circuiting. In some forms of frequency relays the effects of open circuits must also be guarded against.

The introduction of artificial apparent conductance between the rails by the use of inductive bonds also has its advantages and disadvantages. Principal among the advantages is the smaller percentage change in voltage across the relay due to changes in ballast conductance with varying weather conditions. For the same reasons the shunt produced by the train causes less percentage change in voltage across the relay.

These two effects may be taken advantage of in the design of the transformer supplying the track, by making its secondary characteristic with a steeper gradient than where the bonds are not used. The greater the apparent conductance of the bond, the steeper should be the gradient.

The principal disadvantage arising from the introduction of the apparent conductance of the bonds between rails is the extra amount of current taken and the consequent drop in voltage between the track transformer and the relay, with the resultant increase in leakage through the ballast.

It is at this point that the electrical engineer laying out the power system for a road which is to use direct-current propulsion should realize that the higher the efficiency of his return system the cheaper will be the signal system, both in first cost and operation; and when the signal engineer of the road who is making up specifications for the signal manufacturers to bid on comes to the electrical engineer for information as to how much current per rail the bonds must carry continuously, and how much unbalancing they must withstand without causing the signal to go to danger, the electrical engineer must not state an amount which would give 40 per cent loss in the rails, and in addition state that the inductive bonds must withstand 50 per cent unbalancing. The larger the current to be carried by the bond, the greater the first cost of the copper.

The larger the amount of unbalancing the bond must withstand, the larger must be the capacity of the track transformers, the signal mains, and the generating apparatus, and the larger the amount of power to be supplied for the track circuits.

The greater amount of signal current to be supplied to the track circuit because of greater unbalancing capacity in the bonds is due to the fact that this unbalancing capacity is obtained by widening the air-gap in the magnetic circuit of the bond. This of course increases its apparent conductance and the current demands on the track transformers.

With roads using alternating-current propulsion, this unbalancing becomes of minor importance; first, because the return propulsion current is so much smaller; secondly, because the propulsion current being alternating, the actual resistance of the rail has a small ratio to the apparent resistance, and a comparatively large difference in the actual ohmic resistance of the two rails of a track may exist without making any great change in the propulsion current values in the two rails.

The inductive bonds for roads using alternating current for propulsion can therefore be made without an air-gap, and the only effect of unbalancing is to produce a voltage across the terminals of the relay of the same frequency as the propulsion current. This voltage being small with any reasonable amount of unbalancing, it may be taken care of in the frequency relay.

This frequency relay is so constructed that the presence of a voltage across its terminals of the same frequency as that of the propulsion current will not close the relay contacts, the presence of a higher frequency signaling current being necessary to accomplish this result.

The difference in unbalancing effect on roads using direct-current propulsion from that on roads using alternating-current propulsion, together with the higher frequency signaling current, made necessary when alternating-current propulsion current is used in order to operate the frequency relay, constitutes the principal differences in the relations between the elements of the track circuit as used on the two systems; so that what has been written of the double-rail track circuit on the direct-current road applies equally well, with the exceptions noted, to the same system on the alternating-current road.

The State railways of Italy have a mileage of about 7,300 miles, an increase of 2,600 miles since 1885. The lines are roughly divided as follows: (1) The Mediterranean Line, (2) the Adriatic Line, (3) the Sicilian lines, (4) the Southern Line, which, though owned by the government, is still operated by a private company, but is, in effect, a part and continuation of the Adriatic Line. It is estimated that the state has expended since 1860, $893,600,000 for lines and rolling stock for its railroads; and that for the same purposes owners of local, branch, and privately managed lines have spent $231,000,000.

Proportioning of Steel Railway Bridge Members

IN the October, 1907, issue, extracts were published from a paper by Mr. Henry S. Prichard, M. Am. Soc. C. E., on proportioning bridge members, which was presented before the Engineers Society of Western Pennsylvania. In the discussion many letters were received by the society, several of which are given below:

C. D. Purdon, Cons. Eng., S. L. & S. F. R. R.—In reading this paper the first impression is that it is not necessary or desirable to calculate safe working stresses on the available strength of steel while the provision for dynamic effect of live load (or impact) is such an uncertain quantity.

The great range of the impact observed in the B. & O. tests, as quoted in the author's paper, and the equally wide difference of opinion shown in the formula for impact proposed to the American Railway Engineering and Maintenance of Way Association in 1905, show that our knowledge of the effect of impact is, to put it mildly, indefinite.

Could we figure accurately the effect of a load statically and the effect of impact added to this, we might perhaps feel justified in using somewhat higher unit strains than we use at present.

Experiments now being made by Prof. Turneaure will, it is hoped, increase our knowledge of this subject, but apparently it will never be very definite—the effect of impact will be complicated by unbalanced drivers, producing extra strain alternately on either stringers, by flat wheels, by vibration and by possible derailment and for safety the highest of these must be used.

The author says it is difficult to get engineers to commit themselves as to the greatest working stress they permit in an existing bridge before they condemn it. The writer does not consider it possible for an engineer to say what working stress is safe as a general rule. Old bridges, of course, are principally meant in this connection. In a great many cases the original drawings or records of the bridge are lost, but it is not possible to say what the material in the bridge is. The date of building would be an indication to some extent as to whether it is iron or steel, but the quality of it is unknown. The details of the structure are also of great importance. In some cases these are so bad that a span would shake to pieces under loads producing comparatively low unit strains. The behavior of the span under traffic is an important factor, also its physical condition as to rust, wear of pins, loose rivets, etc.

The position of the bridge with respect to the gradients should be noted. It may be in such a place that trains cannot well slow up.

Again, the character of the stream is important. If it be such that false work cannot well be maintained, the span should come out sooner than it otherwise would.

Again, we do not know what is the safe working stress when considered as a load plus impact. Are we to take the formula proposed by the author, or one of the seven proposed to the American Railway Engineering and Maintenance of Way Association? The results differ too widely.

The writer would consider that each span on account of its condition, design and workmanship is a problem by itself and the strain to allow, a matter of judgment, and that to prescribe a certain number of pounds per square inch as safe under all conditions, either with or without some of the impact formula, would not only be misleading, but in many cases cause danger if used blindly by some man in authority who only possesses a smattering of bridge knowledge. Indeed, the quotation on the cover of Cooper's Specifications applies well here.

The statement that if bridges had been proportioned for heavier loads 25 years ago, they would have remained in service much longer is undoubtedly true; but what would have been the effect from a financial standpoint?

The writer has looked up some old records of weight and prices and finds that in 1883 a through Pratt truss of 103 ft. 6 ins. span weighed 121,000 lbs. and cost $5.92 per 100 lbs. delivered, not erected. A span of the same length today, but for a loading of about Cooper E-50 under the American Railway Engineering and Maintenance of Way specifications, would weigh 183,300 lbs. and cost about $3.00 delivered.

Supposing the original span had been designed for E-50 we would have paid

183,300 lbs. at $5.92	$10,851.36
Instead of	
121,000 lbs. at $5.92	7,163.20
Extra cost heavy span	$ 3,688.16
24 years' simple int. 5 per cent.	4,425.84
Cost of original span today	$ 8,114.00
Compare	
183,300 lbs. at $3	5,499.00
Loss by building heavy span originally, counting simple interest only	$ 2,615.00

J. P. Snow, Civ. Eng., West Summerville, Mass.—In reference to the feature of allowable unit strains in existing bridges, the author is undoubtedly safe in recommending 20,000 lbs. per in. in connection with his proposed scheme of impacts. The statement in the paper that the "public recommendations (of engineers) in this regard are liable to be more conservative than their practice" is quite true. Much that has been written on this subject is very vague. To be of value, however, a statement should be definite and it should embody just what we believe.

My experience leads me to believe that old bridges of normal proportions and in good physical condition may be trusted under trains at 20 miles per hour when the unit strains are about twice those ordinarily used in designing new work. At 60 miles three-quarters of this figure should be the limit. This is a very broad general rule and it should be tempered with a careful study of

the action of the structure under loads and with a knowledge of its past history.

The type of bridge has considerable influence in fixing upon the proper limit. Plate girders merit the confidence that all repose in them. Riveted trusses stand next, and well proportioned pony trusses of this class behave better with me than through trusses. Pin trusses built 30 years ago will not bear the unit strains that riveted trusses of the same age will.

To judge if an old bridge is suitable for increased loading is a much more difficult task than to pass on the safety of a bridge for existing traffic. Both timber and metal bridges will show signs of distress a long time before failure need be feared under existing traffic. If it is desired to increase the loading, an engineer can learn much by a study of similar structures that have shown signs of weakness under known loads, and can judge by the strain sheet what will probably be safe on the bridge in question. No hard and fast rule can be laid down however, because no two structures behave exactly alike. The above rule of double the ordinary units, with traffic at moderate speeds, is the best that I can offer for a basis to be used in conjunction with close study in the field.

A. F. Robinson, bridge engr., A., T. & S. F. Sys.—In reference to discussion on Mr. Prichard's paper as to bridge specifications, I find that with the time at my disposal I will not be able to give the discussion that I feel it deserves and that I should like to make. I cannot agree with Mr. Prichard's conclusions and a good many of the assumptions which he is giving as principles.

As to the formula for impact, it seems to me that this is only adding another set of guesses to an already very long series of same. There are now, I think, twelve or fifteen, perhaps more, formulas for impact allowances which are used more or less. It does not seem to me that Mr. Prichard's arrangement is any nearer correct than the others; in many respects it does not seem to meet the general requirements as the formula of Mr. C. C. Schneider. A few years ago I noted Mr. Prichard was recommending an altogether different formula for impact.

During the past year the American Railway Engineering and Maintenance of Way Association has been carrying on an extended series of tests to determine the effect of impact on our bridges. These tests have been made under the hands of Prof. Turneaure, of the University of Wisconsin. The tests have been made in series and a great many of them taken. With these tests there can be no possibility of drawing erroneous conclusions from a few single erratic tests. The number of tests made by Prof. Turneaure and his assistants the past season are probably ten or twenty times as many as all the others previously made, which are referred to in Mr. Prichard's paper.

It is my understanding that these impact tests are to be continued the coming year by the M. of W. Association. During the coming season they expect to make tests on bridges having ballasted floor and on other bridges, which are as near exact duplicates to the above as possible, with open deck. I would suggest that it be wise to hold up final discussion and conclusions regarding Mr. Prichard's paper until such time as the record of the tests already made by the M. of W. Association can be available.

F. E. Turneaure, Dean of University of Wisconsin.—Mr. Prichard's letter on "The Proportioning of Steel Railway Bridge Members" sets forth in an unusually clear manner the fundamental problems relating to the design of bridge members. The writer is in close agreement with the general deductions of the paper, but in the hope of contributing somewhat to the discussion, which doubtless will be exhaustive and very valuable, he would offer some comments relative to certain minor features.

It has been customary with the writer to state the general problem of the determination of the cross-section of bridge members in a slightly different way from that adopted in the paper, and which seems to be a more logical statement. The writer would state the problem as follows:

1. Determination of available strength of material.
2. Determination of the real maximum stresses, so far as practicable, to which the material will be subjected. This includes impact, or dynamic effect, and provision for increase of live load. It may also include in some cases secondary stresses, but these would not be in general calculated.
3. The selection of a working stress to apply to the total calculated stress. This working stress must be less than the permanent elastic limit of the materials to provide for the following:

(a) Defects in material and workmanship; (b) Deterioration of material; (c) Uncalculated stresses such as secondary stresses. This item may also include impact, but preferably not. (d) Contingencies.

The writer believes that a classification, such as above outlined, is logical and lends itself readily to developments in analysis and design. As our knowledge increases concerning such matters as impact and secondary stresses it would seem that better results would be secured by taking care of these items under the head of stress determination rather than in the selection of a working stress. The author's statement appears somewhat confusing on this point, as the term "defects" seems to include impact which, however, is separate considered later. The question of logical arrangement is, of course, not of fundamental importance to the experienced engineer as it would not be likely to modify the final result. The writer would suggest, however, that it is quite important that the item of secondary stresses should be specifically enumerated in the paper, as these stresses are often important and will doubtless be given increasing consideration in the future.

The conclusions which the author derives from his theoretical case of impact do not seem to cover the ground He has presented a formula for a particular case and

given in Table No. 6 some numerical results. Following this table are certain deductions which, the author points out, do not agree with the popular belief. The principal deductions in question are to the effect that an increase of weight of structure increases the impact, while an increase of weight of dead load, not a part of the structure, reduces impact slightly. Perhaps this matter can be cleared up by a more detailed examination of the formula and numerical results. Referring to cases 2, 3 and 4 of the table, it will be seen that the only element which varies is the width and weight of the rectangular beam. The impact increases with the increase in size of beam. Noting again, cases 5 and 6 the external distributed load is increased and the impact is thereby slightly reduced. Again in case 9, as compared to 8, the beam is doubled in depth, but halved in width, leaving its weight the same. The impact is greatly increased. Now the fundamental cause for these results is that in the problem assumed the impact is increased whenever, for any reason, the stiffness of the beam is increased. An increase of stiffness reduces the deflection, the effect of which is to increase the impact, as is evident by inspection of the formula. An increase of weight, however, either in the beam or in its load, without any change in stiffness, causes a decrease in the impact. Stating the results in this way, they seem to be strictly in accordance with experience, and assist materially in understanding the essential effects of weight and stiffness.

A flexible structure is evidently a better form to absorb the energy of a blow than a stiff structure, and hence the impact ratio will be less in the former than in the latter case. In railroad bridges, the impact, or general dynamic effect, is due to two distinct causes, as the author points out. (1) The sudden pressure or blow due to rapidly applied loads, centrifugal force of counterweights, effect of rough track, etc. (2) The vibration resulting from repeated applications of impulses at regular intervals. In short spans, the first-named causes are the only ones of importance; in long spans it is the second group. The first group corresponds roughly with the theoretical case considered; the second group is not covered by the analysis. The correct conclusions would therefore seem to be that in the case of short spans impact is increased with increased rigidity of structure between wheel and masonry, and is somewhat lessened by increase of weight, other things being equal. This statement corresponds with experience as is indicated by the belief in the cushioning effect of ballast and in the use of wooden wall plates, and other means to give greater flexibility in short spans. On the contrary, in long spans the main impact effect, as regards truss members, is caused by the vibration of the entire structure. In this case it is reasonable to suppose that additional weight will tend to reduce the impact, and that increased stiffness may also have the same effect. On these points, however, there is as yet little or no data from which conclusions can be drawn.

In his treatment of impact, with direct reference to the selection of a formula, the author has used the available results of experiments in a conservative manner and has reached conclusions which, to the writer, appear to be reasonable. It is proper to say here that the American Railway Engineering and Maintenance of Way Association, through its committee on iron and steel structures, is undertaking an extensive series of impact tests which it is hoped will throw more light on this subject. During the past summer experiments have been made on some fifteen structures under very favorable conditions. In all cases special test trains were furnished by the railroad company, thus making it possible to make a large number of comparative tests in a short time. A progress report of this work will appear during the coming winter in the publications of the association. It is expected that a much more extensive series of tests will be made during the next year.

Coming Railway Conventions

March 16.—Railway Signal Association at Great Northern hotel, Chicago, Ill. (Regular meeting.) Secretary, C. C. Rosenberg, 12 North Linden street, Bethlehem, Pa.

March 17.—American Railway Engineering and Maintenance of Way Association at Chicago, Ill. Secretary, E. H. Fritch, 962 Monadnock block, Chicago, Ill.

March 26.—Eastern Association of Car Service Officers at New York. Secretary, F. E. Higbie, Jersey City, N. J.

April 22.—American Railway Association at New York. Secretary, W. F. Allen, 24 Park place, New York, N. Y.

April 29.—Association of American Railway Accounting Officers at Washington, D. C. Secretary, C. G. Phillips, 143 Dearborn street, Chicago, Ill.

May 8.—American Institute of Electrical Engineers at New York, N. Y. (Annual meeting.) Secretary, R. W. Pope, 33 West Thirty-ninth street, New York, N. Y.

May 12.—Railway Association of Special Agents and Police of United States and Canada at Lexington, Ky. Secretary, C. H. Dawson, Chicago, Burlington & Quincy, Aurora, Ill.

May 12.—Railway Signal Association at Engineering Societies building, New York, N. Y. (Regular meeting.) Secretary, C. C. Rosenberg, 12 North Linden street, Bethlehem, Pa.

May 20.—Freight Claim Association at Atlantic City, N. J. Secretary, W. P. Taylor, Richmond, Fredericksburg & Potomac, Richmond, Va.

June 9.—Air Brake Association at St. Paul, Minn. Secretary, F. M. Nellis, 53 State street, Boston, Mass.

June 17.—Master Car Builders' Association at Atlantic City, N. J. Secretary, Joseph W. Taylor, 390 Old Colony building, Chicago, Ill.

Process for Treating Small Timbers

THERE is probably no class of wood-users who demand a greater variety of grades of rough and finished lumber than the railroads. The supply of the more durable kinds of wood has decreased to such an extent, with a corresponding increase in value, that short-lived species have, of necessity, been substituted, especially for cross-ties. In many cases railroads have constructed plants for treating timber, by the pressure process. At first these treatments were confined to the less durable varieties of wood, but it has now found profitable to preserve the more durable species and higher grades of lumber, which are subject to decay, such as bridge stringers, car material and rough lumber used in the construction of buildings.

Little attention has been given to the preservation of fence posts and other small timber used along the right of way, though these require millions of feet annually for renewals. Under most conditions, it would not be practicable to treat these timbers at a large pressure plant, and such work would seriously interfere with the operation of treating ties and large timbers.

The Forest Service has recently developed a method which is particularly well adapted for the treatment of fence posts and small timbers but can also be applied to larger stuff. This is known as the open-tank method. There are many advantages in this process and several factors make it of especial value to railroads. The entire outfit can be placed on two cars at very small expense. A flat car would be necessary to hold the tanks and heating apparatus, and a box car for bunk room and storage space. The capacity of the plant would depend somewhat upon the class of material to be treated. As a rule but four men would be required to run the plant, the operation of which is very simple.

It is believed that railroads will find this type of plant well adapted for general use, either independent of or in conjunction with the pressure plants. As a result, the annual charge for maintenance could be reduced at a moderate expense and the available supply of timber materially prolonged.

Timber Preservation Plant, Galesburg, Ill.

A TIMBER preserving plant was erected by the Chicago, Burlington & Quincy Railroad at Galesburg, Ill., for the treatment of soft woods from the southern states. Its construction was described in a recent issue of the Railroad Gazette.

The main building is constructed of reinforced concrete, being 152x115 feet and containing retort, boiler and tank rooms. The crushed stone concrete for beams, roof and floor is of a 1:2:4 mixture and the gravel concrete for walls and foundations of an equivalent 1:3:6 mixture. The reinforced concrete floor panels are 15x30 feet. The roof was mopped with pitch and covered with a composition roofing.

The retort room, which is 152x38 feet, contains three 7/8-inch steel retorts, 132 feet long and 6 feet in diameter, with a capacity of 400 ties to the charge and 24-hour-day plant capacity of 5,000 ties. The plant is equipped for the Card, Rueping or Burnettizing processes.

The boiler room, 46 feet square, is equipped with three 150-h.p. boilers, of which one is for emergency. The engine room, which is 115x30 feet, contains an air compressor, fire pump, three pressure pumps, oil pump and electric generator. The tank room, which is 39x56 feet, contains a 50,000-gallon steel working tank and a 100,000-gallon steel tank for creosote storage.

Outside the building there is a 500,000-gallon steel creosote storage tank, two 5,000-gallon steel creosote measuring tanks and two 50,000-gallon wooden tanks for zinc chloride. All tanks have reinforced concrete foundations with concrete columns resting on piers and joined at top by beams.

The design and construction of the plant was in charge of Mr. W. J. Frein, architect of the Chicago, Burlington & Quincy, and the erection of the building was done by the Knickerbocker Roofing & Paving Company, Chicago.

Shortleaf Pine

SHORTLEAF pine, used extensively for structural, finishing and building material, is found in pure and mixed stands from Staten Island, N. Y., southward to northern Florida, and southeast to the Appalachian states to northeast Texas, over southern Missouri and Kentucky and central West Virginia. The densest stands of this timber occur in southwest Arkansas and the adjacent territories of neighboring states. Northern Arkansas, southern Missouri, northeast Mississippi and northern Alabama also contain heavy stands.

Timbers of this species of pine generally contain considerable sapwood which decreases their durability when used in exposed structures. The presence of sapwood, however, facilitates their efficient treatment with creosote and other preservatives, and with the development of wood preservation the utilization of shortleaf pine for structural timbers will probably increase.

The material upon which the following tests were made was furnished by the leading shortleaf pine manufacturers in Arkansas, and was cut about 15 miles south of Malvern, Ark. The material reached the laboratory at Purdue University, Lafayette, Ind., in a green condition and was tested while thoroughly green. The bending tests were made on pieces ranging in size from 8 by 12 inches by 16 feet to 8 by 16 inches by 16 feet. The modulus of rupture and the modulus of elasticity quoted in the following table are factors which represent respectively the total breaking strength and the stiffness of the material:

STRENGTH OF GREEN SHORTLEAF PINE.

48 Bending Tests on Select and Merchantable Grades.
Sizes 8 ins. by 16 ins., 8 ins. by 14 ins., 8 ins. by 12 ins.—16 ft. long.

	Average	Maximum	Minimum	Average highest 10%	Average lowest 10%
Rings per inch	12.0	23.0	7.0	10.0	7.5
Weight per cu ft. in lbs.—					
Green	44.9	60.2	35.5	55.1	37.0
Over dry	30.6	37.2	24.9	35.7	26.1
Modulus of rupture, lbs. per square inch	5,550	7,730	4,050	7,274	4,254
Modulus of elasticity, 1,000 per square inch	1,470	2,069	1,041	1,917	1,121
Horizontal shearing stress at maximum load, lbs. per sq. in.	313	450	204	313	221
No. of shear failures	11	..	..	2	2

143 Tests in Comparison Parallel to Grain.
Sizes, 6 in. by 6 in. by 24 in. and 5 in. by 8 in. by 24 in.

	Average	Maximum	Minimum	Average highest 10%	Average lowest 10%
Crushing strength at maximum load, lbs. per sq. in.	3,435	4,950	2,150	4,354	2,488

The large number of beams failing in horizontal shear emphasizes the importance of considering this factor in design. Of the 17 select beams, 8 failed in horizontal shear and of the 31 merchantable beams, 3 failed in the same manner. The beams failing in shear showed no checks or shakes before testing, and in both grades developed about the same strength values as the beams not failing in shear.

The green weight per cubic foot of shortleaf pine varies from 35.5 pounds to 60 pounds with an average of about 45 pounds. The oven-dry weight (dried at 212 F.) per cubic foot varies from about 24 pounds to 37 pounds with an average of about 30.6 pounds.

Other tests of large-sized timbers by the Forest Service may be found in Circular 115, "Second Progress Report on the Strength of Structural Timber." The shortleaf pine with a modulus of rupture of 5,550 pounds per square inch is practically equal to loblolly pine with a modulus of rupture of 5,580 pounds. Shortleaf pine is, however, not as variable in characteristics of growth and structure as loblolly. Shortleaf and loblolly are both inferior in strength to longleaf pine, whose modulus of rupture is 7,160 pounds per square inch for partially air-dried material. The strength of shortleaf is about 85 per cent of that of Douglas fir. Eastern tamarack is about 20 per cent weaker than shortleaf, and Norway pine about 30 per cent weaker. All these comparisons, except for longleaf pine, are based upon large timbers of commercial grades tested green.

Prices on Track Materials, F. O. B., Chicago

TRACK SUPPLIES.

Steel Rail, 60 lbs. and over .....$28.00 per gross ton
Steel Rail, 25 to 45 lbs. ..... 28.00 per gross ton
Steel Rail, 20 lbs. ..... 29.00 per gross ton
Steel Rail, 16 lbs. ..... 30.00 per gross ton
Steel Rail, 12 lbs. ..... 31.00 per gross ton
Ties, 6x8x8 oak, 1st grade .....74c each
Ties, 6x8x8 oak, 2d grade .....67c each
Switch Ties .....$27.00 to $28.00 M. ft.

Angle bars, accompanying rail orders, 1908 delivery, 1.65c.; car lots, 1.75c. to 1.85c.; spikes, 1.90 to 2.00c., according to delivery; track bolts, 2.40c. to 2.50c., base, square nuts, and 2.55c. to 2.65c., base, hexagon nuts. The store prices on track supplies range from 0.15c. to 0.20c. above mill prices. Switch set per turn out, 85-lb. rail, $100 to $105.

OLD MATERIAL.

Old Steel Rails, rerolling .....$12.50 to $13.00
Old Steel Rails, less than 3 ft..... 12.25 to 12.75
Old Iron Rails ..... 16.00 to 16.50

SHEET STEEL.

It is quoted for future delivery:

Tank plate ¼-in. and heavier, wider than 6¼ and up to 100 in. wide, inclusive, car lots, Chicago, 1.88c. to 2.08c.; 3-16 in., 1.98c. to 2.18c.; Nos. 7 and 8 gauge, 2.03c. to 2.23c.; No. 9, 2.13c. to 2.33c. Flange quality, in widths up to 100 in., 1.98c. to 2.08c., base for ¼-in. and heavier, with the same advance for lighter weights; Sketch Plates, Tank quality, 1.98c. to 2.18c.; Flange quality, 2.08c. Store prices on Plates are as follows: Tank Plate, ¼-in. and heavier, up to 72-in. wide, 2.20c. to 2.30c.; from 72 to 96 in. wide, 2.30c. to 2.40c.; 3-16 in. up to 60 in. wide, 2.30c. to 2.40c.; 72 in. wide, 2.50c. to 2.65c.; No. 8 up to 60 in. wide, 2.35c. to 2.45c.; Flange and Head quality, 0.25c. extra.

STRUCTURAL STEEL SHAPES.

Store quotations are unchanged at 2.05c. to 2.10c., and mill prices are as follows: Beams and Channels, 3 to 15 in., inclusive, 1.88c.; Angles, 3 to 6 in., ¼-in. and heavier, 1.88c.; larger than 6 in. on one or both legs, 1.98c.; Beams, larger than 15 in., 1.98c.; Zees, 3 in. and over, 1.88c.; Tees, 3 in. and over, 1.93c., in addition to the usual extras.

CAST IRON PIPE.

Quotations per net ton on Water Pipe, 4 in., $31; 6 to 12 in., $30; over 16 in., $29; with $1 per ton extra for gas pipe.

CEMENT.

Good grade Portland Cement, car lots...$1.65 per bbl.*

* (Four sacks per bbl. credited 10c each when returned in good condition.)

SAND.

Bank sand, car lot .....$0.75 per yd.
Torpedo sand, car lot ..... 1.15 per yd.

CRUSHED STONE GRAVEL.

Crushed limestone, car lot.....$1.05 per yd.
Crushed gravel, car lot ..... 1.00 per yd.

Personals

Mr. W. B. Barclay has been appointed general manager of the Halifax & Southwestern, the Canadian Northern Ontario, the Canadian Northern Quebec and the Inverness Railway & Coal Company, with headquarters at Montreal, Que., succeeding Mr. W. C. Spencer, resigned.

Mr. D. C. King has been appointed roadmaster of the Ft. Worth & Rio Grande at Ft. Worth, Tex., in place of Mr. M. M. Birdsong, resigned.

Mr. W. F. Fraylick has been appointed roadmaster of the Southern at Charleston, S. C., in place of Mr. J. E. Fowler. Mr. W. A Vowell has been appointed supervisor of bridges and buildings at Branchville, S. C., to succeed Mr. L. L. Metcalf.

Mr. C. H Fisk has been appointed chief engineer of maintenance of way of the Colorado Southern, New Orleans & Pacific, with headquarters at Beaumont, Tex.

Mr. James B. Cox, who in October last resigned as chief engineer of the Chicago Junction Railway, has engaged in practice as consulting engineer, with offices in the Railway Exchange, Chicago.

Mr. Henry Martin, superintendent of terminals of the Mobile & Ohio at Mobile, Ala., has been appointed inspector of transportation of the Ft. Worth division of the International & Great Northern at Palestine, Tex.

Mr. J. M. Bennett, superintendent of the Durham division of the Southern, has been appointed superintendent of the Winston-Salem division, with headquarters at Winston-Salem, N. C., succeeding Mr. A. M. Smith.

Mr. George W. Payne has been appointed chief engineer of the Missouri Southern, with office at Leeper, Mo.

Mr. E. J. Bohanan, roadmaster of the Chicago, Rock Island & Pacific at Little Rock, Ark., has been appointed roadmaster of the Missouri, Kansas & Texas at Denison, Tex.

Mr. J. R. Cameron, superintendent of the Canadian Northern at Port Arthur, Ont., has been appointed general superintendent, with headquarters at Winnipeg, Man.

Mr. A. G. Abell has been appointed superintendent of the Valley division of the Missouri Pacific, with office at Monroe, La., succeeding Mr. C. H. Bevington, resigned.

Mr. J. Kinucan has been appointed superintendent of terminals of the Atchison, Topeka & Santa Fe Coast Lines at San Francisco, Cal.

Mr. C. S. McCurdy has been appointed roadmaster of the Missouri & North Arkansas at Eureka Springs, Ark., to succeed Mr. N. P. Anderson, resigned.

Mr. G. F. Moore has been appointed general manager of the St. Joseph Valley Railway, in charge of traffic and operation, with headquarters at La Grange, Ind.

Mr. B. D. Folwell has been appointed purchasing agent of the Buffalo & Susquehanna with headquarters at Buffalo, N. Y.

Mr. C. H. Beatty, formerly superintendent of the Nevada Northern, is now connected with the construction department of the Cananea, Yaqui River & Pacific at Navajoa, Mex.

Mr. W. S. Menden has been appointed assistant general manager and chief engineer of the Brooklyn Rapid Transit Company, with headquarters at 85 Clinton street, Brooklyn, N. Y. The office of general superintendent has been abolished and Mr. Arthur N. Dutton has been appointed superintendent of transportation, effective on January 1.

Mr. T. Fitzgerald has resigned as general manager of the Baltimore & Ohio, but it is stated that he will probably remain with that company in another capacity. Mr. Fitzgerald has been connected with the Baltimore & Ohio for 40 years and has been general manager since February 1, 1905, previous to which time he was general superintendent for five years.

Rail Chairs

The T. H. Symington Company, of Baltimore, is now manufacturing a unique design of malleable iron rail chair for concrete construction, as illustrated. This chair was patented by Mr. E. A. Gilchrist with the idea of furnishing a strong, durable, simple and cheap device for a bond between concrete roadbed and rail.

MALLEABLE IRON RAIL CHAIR

The chair, of course, can be designed for all conditions of service, type of rail, etc. In service the chair is completely embedded in the concrete, and by means of a simple clamp the rail is held in its proper position. The device is more simple than any type of chair heretofore brought out, and is as effective as it is simple.

The Symington Company is prepared to manufacture chairs to met any and all conditions and in any quantity.

Continental Whistling Post

It is now possible to replace the familiar white tombstones with their black "W" and "R" that appear along railways at crossings and cuts by durable, cheap and attractive steel whistling posts. The Continental post has been designed especially to reduce the high cost of maintenance, to give longer life to the post and to keep the first cost as near that of the wooden post as possible.

The post is made by bending a Carnegie 32-pound T-section, 1¾ by 1¾ inches, into an inverted U-shape, 7 feet long and 13 inches wide outside, and mounting it in a concrete base. Five inches from the open end a wrought-iron bar 1 by ½ inch is riveted to connect the legs, and this also serves to anchor the arch in the base. The base is 8 by 16 by 30 inches, the steel being embedded 12 inches.

The letters "W" and "R" for these posts are stamped from ⅛-inch sheet iron and are 8 inches high with a width of line 1½ inches. They can be white enameled if desired.

The claims for this post are that, being made of structural steel, it will outlast the wooden post by many years; it will reduce the amount of paint used to maintain the posts by at least 75 per cent; it will reduce the amount of time necessary to properly maintain the posts by at least 75 per cent; the letters will be silhouetted against any background in winter or summer; snow cannot drift against it; letters can be held in stock and new ones attached to a post at any time; in all weather and under all conditions it will be efficient as a warning to the engineer.

This device is the invention of E. D. Hillman, mechanical engineer of the United States Metal & Manufacturing Company, New York, which company will shortly place the post on the market.

Trade Notes

Disc Grader & Plow Company, Hunter, N. Dak., have recently issued a small pamphlet on "The Rotary Disc Plow." They are manufacturers and patentees of rotary disc plowing attachments for elevating graders. Recommendations of several contractors are included.

The Standard Steel Works Company, Philadelphia, Pa., issued an interesting catalog on "Springs" for railway and electric traction service. In the pamphlet, the methods of manufacture and testing as well as concise descriptions with clear illustration are given. The last few pages are devoted to reduced fac-simile order blanks which the company furnishes free of charge. These hectographs are printed in aniline copying ink and measure 8½x12½ inches. They contain line drawings with blank spaces for all information necessary to produce the springs.

St. Louis Surfacer & Paint Company, St. Louis, Mo., announces that H. N. Turner has been appointed manager of sales in the railway department. Mr. Turner has been connected with the Acme White Lead & Color Works of Detroit, Mich.

Birmingham Frog & Switch Company, Birmingham, Ala., has been incorporated with a capital stock of $5,000,000 by Everett Dufour and G. A. Talbott, of Washington, D. C., and E. L. McKeown, Guthrie, Okla.

American Creosoting Company, 600 Ellsworth building, Chicago, at its annual meeting, elected Henry C. Starr of Richmond, Ind., president; J. C. Dickinson of Chicago, vice-president; and J. Everett Lemon of Chicago, secretary-treasurer.

Theodore Thomas & Co., Great Northern building, Chicago, Ill., announce that they have entered into an arrangement with the Helwig Manufacturing Company of St. Paul, Minn., whereby they will handle the sale, in the Chicago territory, of the Helwig pneumatic tools, of which a complete line of samples will be kept on hand for exhibition purposes.

Robert W. Hunt & Co., Chicago, inspecting and consulting engineers, have decided to establish a branch office and chemical laboratory at St. Louis, Mo. This representation will be under the charge of Charles W. Gennett, Jr. Mr. Gennett graduated with the degree of mechanical engineer from Cornell University in 1898, following which he was employed in the drafting room of the Baldwin Locomotive Works, and later in the inspecting and testing department of the Southern Railway. During the latter part of his connection with that organization he was in charge of their inspection work in Pittsburg and the west. Since then, and up to the time of entering the service of Robert W. Hunt & Co., he has been the western sales agent of the Atha Steel Casting Company, with headquarters in Chicago.

Railway Specialty & Supply Company, Great Northern building, Chicago, has been appointed agent for the Hayes Track Appliance Company, Geneva, N. Y., in the Chicago district. The company is prepared to furnish catalogues and issue descriptive matter and all information desired in connection with the Hayes derail.

Lancaster Automatic Railway Crossing Company, Manchester, Va., has been organized by A. J. Montague, Richmond, Va., and others, to establish a plant at Manchester for the manufacture of an automatic safety railway crossing.

Republic Railway Appliance Company of St. Louis, Mo., has opened an office in Chicago at 1538 Monadnock block. W. M. Baxter, vice-president of the company, is in charge.

The Raymond Concrete Pile Company of Chicago and New York has been awarded the contract for placing the piles for the foundations of the new Smith Street Power House of the Coney Island and Brooklyn Railway Company at Ninth and Smith streets and Gowanus canal, Brooklyn. Ford, Bacon & Davis are the engineers. A. Pasquini is the general contractor. Concrete piles were substituted at a conspicuous saving over wood piles, involving the disregarding of the water line, a considerable saving in concrete and the placing of heavier loads per pile.

The Association of Licensed Cement Manufacturers was organized in New York on January 9th by the North American Portland Cement Company, the Atlas, Alpha, American, Lehigh, Lawrence, and Vulcanite Portland cement companies, and various other important companies in the East and West, including the Dexter, Edison, Nazareth, Pennsylvania, Penn-Allen, and Catskill, all of which have secured licenses under the Hurry and Seaman, Edison, Carpenter, and other patents controlled by the North American company. Other applications for membership have been presented and are under consideration. The officers of the association are A. F. Gerstell, vice-president and general manager of the Alpha Portland Cement Co., president; Conrad Miller, president of the Dexter Portland Cement Co., vice-president; and Alfonso De Navarro, vice-president of the Atlas Portland Cement Co., secretary and general manager.

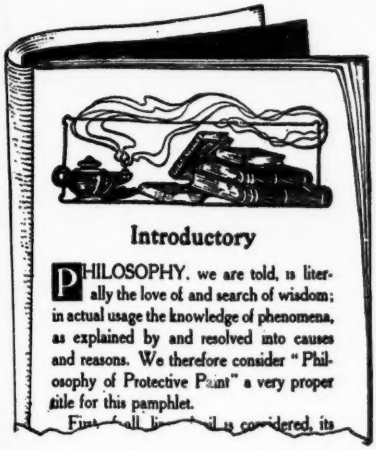
Technical Publications

MANUAL OF RECOMMENDED PRACTICE FOR RAILWAY ENGINEERING AND MAINTENANCE OF WAY. Published under direction of the Committee on Publications by the American Railway Engineering and Maintenance of Way Association, Chicago, Ill. Cloth or half-morocco binding, 291 pages, 6x9 inches, illustrated. Price: cloth, $3.00, and half-morocco, $3.50.

The book contains definitions, specifications and principles of practice adopted by the above mentioned association from its first convention to and including its eighth annual convention in March, 1907. Only such practice as has been finally accepted by the Association is given in the manual.

In this volume is represented the combined efforts of the leading railway engineers toward standardization in all lines covered by the engineering department. This fact gives sufficient reason to say that every railroad engineer should have a copy in his possession.

Each year since the organization of the Association, additional data has been presented by the various committees and this has been put into such shape in this volume that it may be readily referred to by the engineer. A chapter covers the reports of a committee on a single subject, such as roadbed, track, masonry, iron and steel structures, etc. There are in all 16 chapters and the subjects are similar to those outlined elsewhere in this issue under the synopsis for the next annual convention.



Introductory

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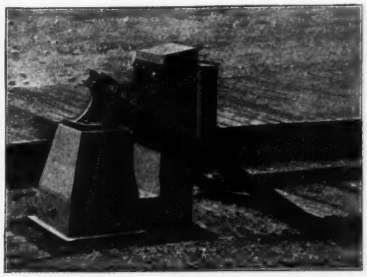

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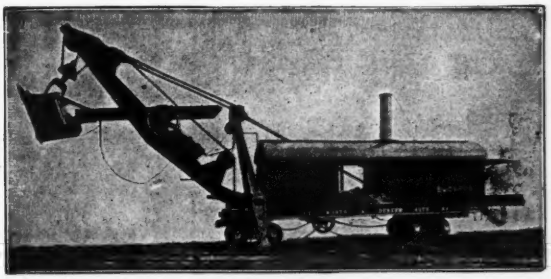

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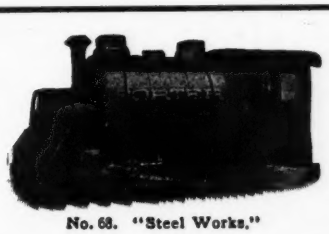
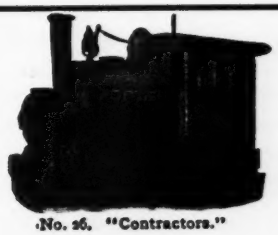


No. 68. "Steel Works."



No. 26. "Contractors."

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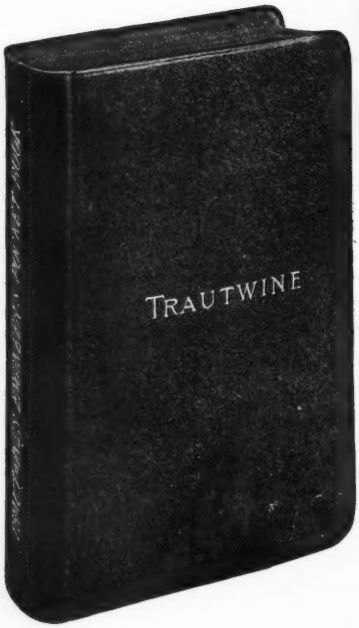

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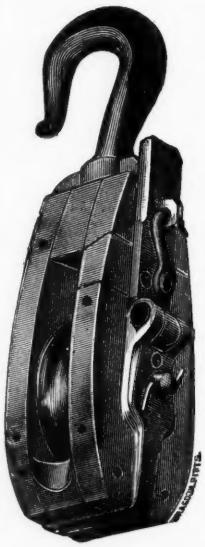

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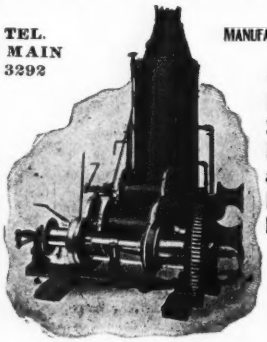

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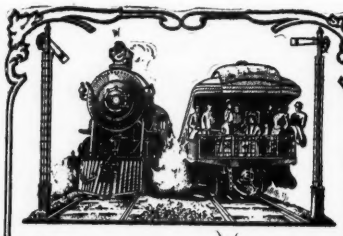

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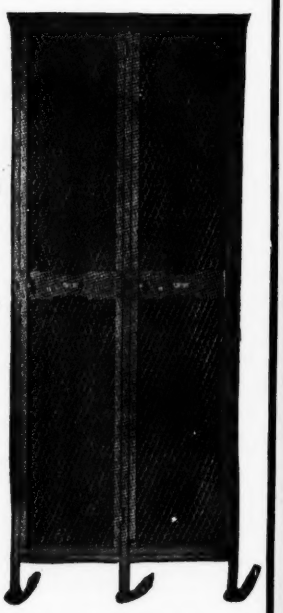

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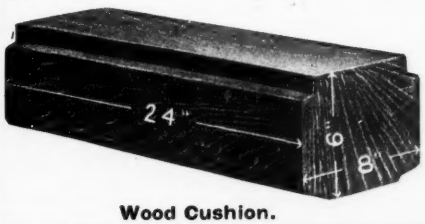

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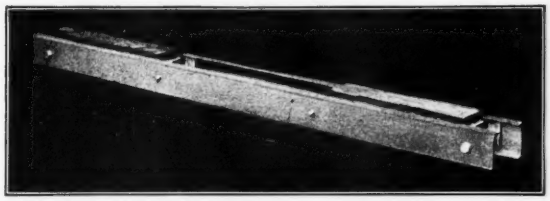

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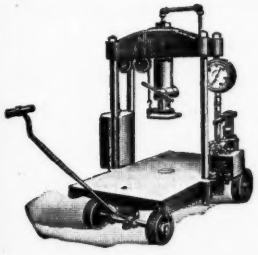

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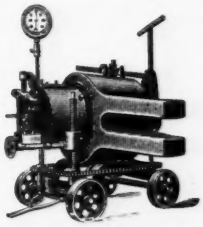

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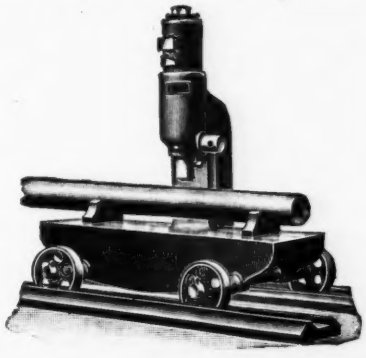

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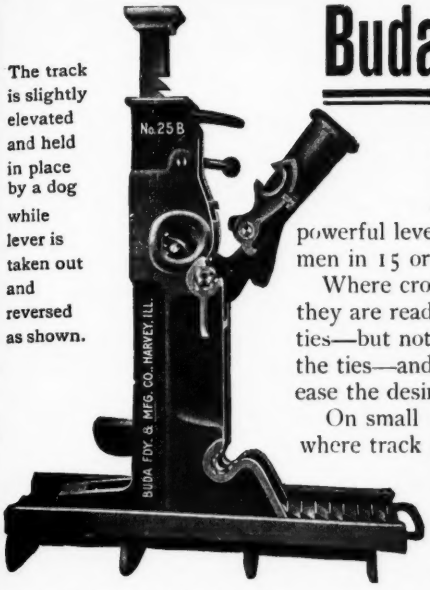

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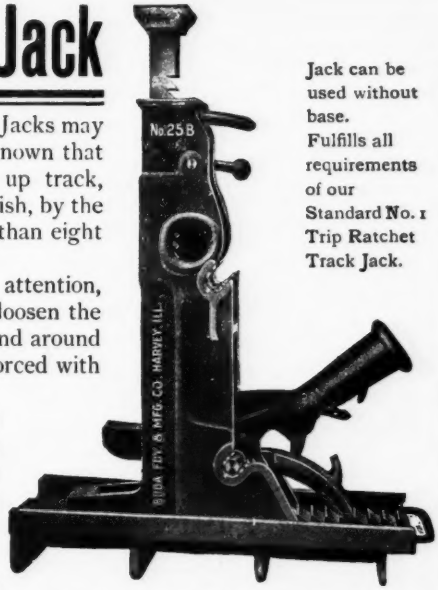

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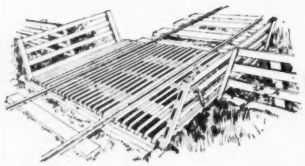

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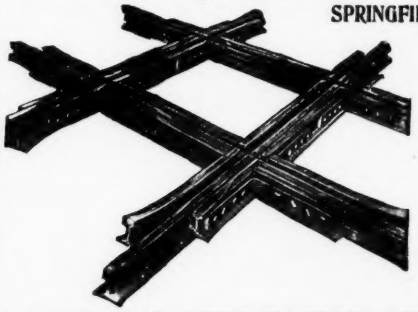

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